500-78-0062

FINAL REPORT

PHYSICIAN DECISION MAKING: AN ANALYSIS OF WORK ENVIRONMENT, INPUT, PRICING, INCOME AND LABOR-LEISURE CHOICES

by

Anthony E. Boardman*, principal investigator
Bryan E. Dowd**
John M. Eisenberg***
Sankey V. Williams***

* University of British Columbia
** University of Minnesota
*** Section of General Medicine:
Hospital of the University
of Pennsylvania

March 1980

388 [illegible] 0062

FINAL REPORT

PHYSICIAN DECISION MAKING: AN ANALYSIS OF WORK ENVIRONMENT, INPUT, PRICING, INCOME AND LABOR-LEISURE CHOICES

by

Anthony E. Boardman*, principal investigator

Bryan E. Dowd**, John M. Eisenberg***, and Sankey V. Williams***

*University of British Columbia

**University of Minnesota

***Section of General Medicine:

Hospital of the University

of Pennsylvania

May 1981

This report is made pursuant to Contract #HCGA 500-78-0062. The charge to the Department of Health and Human Services for the work resulting in this report (inclusive of the amount so charged for any prior reports submitted under this contract) is $52,137. The names of the persons, employed or retained by the contractor, with managerial or professional responsibility for such work, or for content of the report are as follows: Anthony E. Boardman, Bryan E. Dowd, John M. Eisenberg and Sankey V. Williams.

Table of Contents

1. Introduction.. 2

2. Previous Studies of Physicians' Practice Decisions

  a) Introduction...................................... 6
  b) The Supply and Price of Physician Services...... 6
  c) Physician Productivity........................... 20
  d) Production Function.............................. 22
  e) Physician choice of Specialty.................... 24
  f) Physician choice of Geographic Location 25

3. Physicians' Practice Styles

  a) Introduction...................................... 26
  b) Review of Factor Analysis........................ 32
  c) Identification of Practice Styles............... 34
  d) Determinants of Practice Styles................. 42
  e) A Casual Model of Physicians' Styles............ 51

4. Confirmatory Analyses of Complete Causal Model

  a) Analysis of Practice Attribute Variables........ 65
  b) Addition of the Exogenous Variables............. 67
  c) Formulation of complete Causal Model............ 71
  d) Analysis of Results.............................. 84

5. Summary...102

References...106

1. INTRODUCTION

Over the past twenty years the price of all goods and services has risen dramatically. However, the annual rate of increase of the consumer price index for health care services has consistently risen faster than the overall annual rate, and the health care sector's proportion of the gross national product continues to rise. In response to concerns about the increasing costs of health care, policy analysts have turned their attention to the economic impact of decisions made by physicians regarding the organization of their practices and the treatment of their patients.

Physicians have tremendous control over the characteristics of their work environment. Through choice of practice location they determine the characteristics of their leisure environment. Through choice of specialty they determine, within certain limits, the types of illnesses they will treat. Through the decision to work in a solo or group practice they can determine the type of office practice and the degree to which responsibilities will be shared. Within certain limits they can also determine the socioeconomic and demographic characteristics of their patients. They can control the hours they do not work (the amount of leisure time) and, for the working hours, they can determine to some extent how many will be spent in direct consultation or treatment of patients and how many will be spent on administrative tasks. Through the number of hours that they work they can significantly affect their income and, unlike most professionals, they have considerable flexibility in setting fees. Furthermore, physicians order auxiliary services and determine the length of impatient stays. Thus, physicians make many decisions that affect the quality, quantity and cost of health care.

The purpose of this research is to model physician decision making behaviour and, through the analysis of two comprehensive datasets, to determine the factors that affect these decisions. Particular decisions on which we focus include the choice of specialty, the type and size of practice, patient mix characteristics, pricing practices, the use of time and labor/leisure choices, and income.

Previous models represent the physician as a profit maximizing firm or as a utility maximizing consumer. Generally, these models, which are reviewed in chapter two, examine one decision at a time and treat all other variables as exogenous. For the physician, however, few variables are exogenous. For example, in the traditional economic approach to the study of labor supply, economists assume that income is determined by the wage rate and the number of hours worked and derive labor supply functions which depend on the wage rate. In such analyses, it is usually reasonable to assume that wages are predetermined. Physicians, however, exert control not only over their hours worked and their income, but also the prices they charge. Further, the prices they charge may well depend on their income and number of hours of labor supplied. Other decisions also appear to be jointly determined. Each decision appears to depend on many of the other decisions, and there may be few predetermined variables that are of policy interest.

The major focus of this research is to recognize that while physicians enjoy a certain amount of flexibility, we argue that instead of choosing each decision variable separately, a physician chooses a "style" or "norm" of behavior which defines certain typical characteristics of his work environment. In other words, there are only a limited number of "styles" of physician

behavior. Once a physician has chosen one of these styles, certain characteristics of his work environment remain fixed or will change only slightly in the short run. We suppose that the "style" of practice is characterized by hours worked in each of a variety of settings, number of patients seen in those settings, use of administrative aides, number of physicians in the practice, the way in which the physician is paid, and by the mix of patients (concerning both their demographic characteristics and the type of reimbursement i.e., Medicare, Medicaid, self-paid, etc.). An example of an hypothesised style is the "Medicaid mill" which is characterised by many patients, a high proportion of which are eligible for Medicaid, and, potentially, many aides, many hours worked in the office by the physician, who receives a reasonably high income. One can appreciate that many styles exist.

The first major purpose of this research is to identify and describe the predominant styles of office based physicians. The second major purpose is to develop and estimate a causal model of the determinants of practice styles. Specifically, we examine the effects of specialty, board certification, practice size, characteristics of the geographic location, and the physician's sex, race, experience and non-practice income on style of practice. This research is reported in Chapter 3.

Our research differs substantially from previous research in this area. Since the model is quite novel we use one dataset--the 1975 Physicians' Administrative Practices Survey--for exploratory purposes to aid the development of the model. A similar but independently collected dataset--the 1976 Survey--was used exclusively for confirmatory purposes. The confirmatory analyses are presented in Chapter 4. For the most part the results are extremely robust and for some styles the goodness of fits are very high.

In this report we have initiated a new line of inquiry into the ways in which physicians make decisions about their practices. Physicians' styles appear to be useful in their ability to explain the variance in the practice attributes and they correspond to intuitively appealing concepts that have arisen from previous research. The concept of physicians' styles recognises that at least some decisions concerning fees, labor supply and productivity are made simultaneously. Consequently, manipulation through legislation of some practice attributes, such as Medicaid fees, may cause simultaneous, undesirable adjustments in other practice attribute characteristics. At the same time physicians who do not have a high proportion of Medicaid patients may be totally unaffected.

The causal model attempts to show under what circumstances policy makers may expect to witness more physicians adopting a certain style. We find, for example, that in physican-rich areas more physicians adopt a style characterised by high fees. Thus, while an increase in physicans' supply may lead to an increase in the provision of health services, our research suggests that fees will simultaneously increase on average.

2. PREVIOUS STUDIES OF PHYSICIANS' PRACTICE DECISIONS

a) Introduction

Much of the previous work on physicians' practice decisions has been based on economic models. There exists some concern, however, that one may not expect great success from efforts to model the organization of the physician's practice as economic choices. In response to Evans' attempt to unravel the inner workings of the "black box" of the physician's practice [Evans, 1976] Frenzel comments:

> If the reason for getting into the 'black box' is to explain why physicians behave as they do, then one might wonder what an economist is doing there. While the ostensible structure, behavior and performance of industries and firms is standard fare for economists, we (economists) have not been notably successful in discovering the subjective bases of behavior or in relating them to observed behavior in a variety of other settings. [Evans, 1976, discussion]

Economists might reply that individuals, firms and industries do not make decisions by the mathematical processes inherent in economics models, but they behave as if they did (Friedman, 1935). Thus predictions that arise from economic models can be used to predict the response of individuals, firms and industries to a variety of stimuli. The value of the economic model depends on the insight that the model provides and the usefulness and accuracy of the predictions. In the following section we review the most useful economic models.

b) The Supply and Price of Physician Services

b.i) Introduction

Previous economic models of physician practice decisions have focused on the price and supply of physician services. These two variables form the basis for most policy-related discussions of the physician's practice.

Major reviews of the economics literature have been written by Bloom and Martin (undated), Evans (1972, 1976), Feldstein (1973), and Williams (1977). Two major issues characterize the literature. The first issue is whether the physician operates in a monopolistic or competitive environment. The second issue is whether the physician behaves as a profit or utility maximizer. In general, utility maximizing consumer models allow for labor-leisure preferences in the objective function while profit maximizing firm models do not. The possible types of models are represented in Table 1. Each cell of this matrix contains appropriate literature.

	Profit Maximizer	Utility Maximizer
Price taker (competitive)	Fuchs & Kramer (1971)	Sloan (1973) Brown & Lapan (1979)
Price setter (monopolistic)	Newhouse (1970)	Feldstein (1970) Newhouse & Sloan (1972) Masson & Wu (1974) Pauly & Satterthwaite (1978)

TABLE 2.1: Typology of Previous Research

We begin our review with the profit maximizing - price taking models. We then discuss profit maximizing - price setting models, followed by utility maximizing - price taking models and then utility maximizing - price setting models. Next, we discuss the "markup" model of Steinwald and Sloan (1974), which is really a price setting model but physicians are neither profit maximizing nor utility maximizing. Productivity as distinct from supply is discussed in section (c).

b.ii) Profit maximizing, price taking models

Conceptually, the profit maximizing, price taking model can be written:

$$\max \quad pQ - c(Q) \tag{2.1}$$

$$\text{s.t.} \quad Q = Q(L;N) \tag{2.2}$$

The physician maximizes profit (2.1) subject to the production function (2.2) in order to determine the profit maximizing level of physician services to supply. Physician services (Q) are a function of physician input (L) and other inputs (N). p is the exogenously determined price per physician service, and $c(Q)$ is the cost of supplying Q units of physician services. Maximization of this model with respect to Q yields the familiar result that physicians will produce services until marginal cost equals price.

In order to equate price, which is fixed, with marginal cost and to produce positive levels of services, marginal cost must increase as output increases.[1] In order for this to hold, if input prices are fixed, there must be decreasing returns to scale in the short-run production process. However, one may question whether these returns to scale decrease sufficiently quickly to raise marginal cost to the level of output prices. If not, one would expect physicians to work twenty-four hours a day and to produce maximum possible levels of services. To avoid this problem we could modify the cost function, $c(Q)$, so that it reflects the physicians valuation of a "wage", his own time. Alternatively, we could abandon the profit maximization model and allow for labor-leisure trade-offs in the objective function. We review such utility maximization models later in this section.

---

[1] This result follows immediately from the second order conditions for a maximum.

The above model assumes the output price, which the physician takes as constant, results from the equilibrium of aggregate demand and supply. If this were the case we would expect that as the number of physicians increases (holding population constant), the supply curve would shift out, which would result in (a) a reduction in the price of physician services and (b) an increase in the quantity of physician services. Fuchs and Kramer (1971) imply that their empirical results are contrary to these predictions; they observe a negative relationship between the number of physicians per capita and volume of services per physician. However, this result implies only that the marginal increase in total output due to an additional physician is less than the average output per physician. According to Feldstein (1973), while Fuchs and Kramer's "evidence appears to favor the absence of any effect of price on supply, the existence of a positive price effect can be rejected with greater confidence."

b.iii) Profit maximizing, price setting models

Newhouse (1970) examined physicians pricing models in an attempt to distinguish between competitive and monopolistic supply models. Newhouse argued that a positive correlation between the price of physician services and physicians per capita was conclusive evidence of a monopolistic market for physicians' services. Frech and Ginsburg (1972) showed that if both models assume rising marginal costs, neither model is supported by Newhouse's data. Newhouse and Sloan (1971) subsequently concur and suggest that perhaps physicians are not profit maximizers after all, but instead, set prices to achieve a target income.

b.iv) Utility maximizing, price taking models

Sloan (1973) postulates a utility maximizing, price taking model. He examines the effect of the physician's wage rate on his labor supply, which is measured in two ways: the number of weeks worked per year and the number of hours worked per week. The former equation contains wage per week as an explanatory variable while the latter equation contains wage per hour. Since Sloan does not have direct observations of the wage measures he first obtains estimates of them by regressing the ratio of annual income to weeks worked per year and the ratio of annual income to hours worked per year on a number of exogenous variables. Using these estimated parameters he obtains predicted measures of the wage variables which are then included as explanatory variables in the labor supply equation. These equations are also estimated by ordinary least squares.

The estimated supply equations have low R^2 (none higher than 0.16) and few variables are significant. Similar to Fuchs and Kramer, Sloan finds little relationship between wages and labor supply. The four dummy variables for age are always significant and indicate that hours worked per week decreases as age increases. While significant, age does not exhibit the same clear pattern in the weeks worked equation. Female physicians with children tend to work less. Physicians who are employed by a private company or the government work fewer hours per week than other physicians although the number of weeks worked does not vary significantly with type of employment.

b.v) Utility maximizing, price setting models

In his empirical sections Sloan treats wages as fixed. In his theoretical sections, however, he acknowledges that wages may decrease as hours of work increase. We shall examine this point and a more formal description of the

price taking, utility maximizing model by reviewing the paper by Brown and Lapan (1979).

Brown and Lapan propose the following model:

$$U = U(C,T) \qquad (2.3)$$

$$Q = F(L,N) \qquad (2.4)$$

$$\hat{I} + PQ - RN - \bar{p}C = 0 \qquad (2.5)$$

Where U(C,T) denotes the utility derived from the consumption of goods (C) and leisure ($T = A-L$; A is a constant). The output of physicians services (Q) is a function of his time inputs (L) and other inputs (N). The price of Q, denoted by P, is a constant as is the price of N, denoted by R, and the price of C, denoted by $\bar{p}$. $\hat{I}$ is physician income from outside sources. Finally, let $n = N/L$.

The physicians' income from his practice is given by:

$$Y = PQ - RN \qquad (2.6)$$

The "wage" of the physician, W, is the average income per hour worked:

$$W = \frac{Y}{L} = \frac{PQ}{L} = \frac{RN}{L} \qquad (2.7)$$

It is important to recognize that W is a function of L. Taking the first derivative of W with respect to L we obtain:

$$\frac{\partial W}{\partial L} = \frac{P}{L}\frac{\partial Q}{\partial L} - \frac{PQ}{L^2} + \frac{RN}{L^2}$$

$$= \frac{P}{L}\frac{\partial Q}{\partial L} - \frac{Y}{L^2}$$

$$= \frac{P}{L}\frac{\partial Q}{\partial L} - \frac{W}{L}$$

$$\frac{\partial W}{\partial L} = \frac{1}{L}\left[P\frac{\partial Q}{\partial L} - W\right] \qquad (2.8)$$

Thus, when L is small ($P\frac{\partial Q}{\partial L}$ is greater than W) W is an increasing function of L but when L is large ($p\frac{\partial Q}{\partial L}$ is less than W) W is a decreasing function of L.

This illustrates Sloan's argument that the wage decreases as hours worked increases. In addition to the reason given above, Sloan suggests that the wage rate will fall as hours worked increases if the price (P) varies inversely with Q and, therefore, if P varies inversely with L. The following figure illustrates these points:

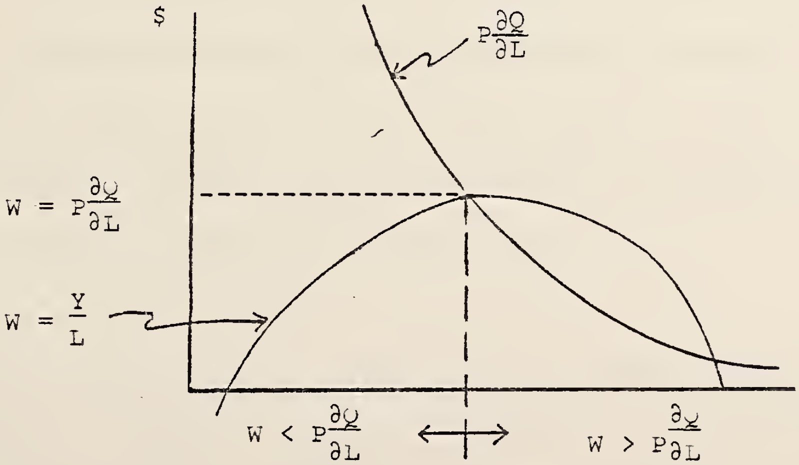
$
$P\frac{\partial Q}{\partial L}$
$W = P\frac{\partial Q}{\partial L}$
$W = \frac{Y}{L}$
$W < P\frac{\partial Q}{\partial L}$
$W > P\frac{\partial Q}{\partial L}$

Figure 2.1: Relationship Between Wage and Labor Supply

Brown and Lapan derive the first order conditions for a maximum and estimate the supply curve for physicians' services. They find that the supply curve is upward sloping. They use these estimates to compute the elasticity of the labor supply equation which they find is backward bending. However, in order to compute this elasticity it appears they have assumed that the physicians' wage rate is fixed.

Feldstein (1970) models the physician as a price setting, utility maximizing consumer in an imperfectly competitive market with preferences for income, leisure and the characteristics of his work -- in particular, the characteristics of his patients. Since patient characteristics are important to the physician, Feldstein argues that the physician will set his fees below the market clearing prices. The resultant excess demand allows the physician to be selective about the patients he treats.

The most interesting result from Feldstein's estimated price equation is that the elasticity of the insurance variable suggests that more than one-third of increased insurance coverage is diluted by induced price increases. Apparent evidence for the existence of excess demand is provided by a positive elasticity of demand with respect to price. In a subsequent article, however, Feldstein, Brown, and Lapan (1974) concur that this result is possible even if there is no excess demand.

Feldstein also estimates supply equations and obtains downward sloping supply curves. However, when the physician acts as a price setter, as Feldstein assumes, specification of the supply equation is difficult because the physician sets price and quantity simultaneously.

Although characteristics of the work environment are included in the utility function of Feldstein's model, he does not derive demand equations for patient characteristics.

Feldstein was the first author to include, implicitly or explicitly, patient characteristics in the physician's utility function. These characteristics served to justify the excess demand argument.[2] One might have expected Feldstein to derive demand curves for patient characteristics, but he does not do this. We return to a fuller discussion of the treatment of patient characteristics later.

A well documented empirical finding is the positive correlation between physicians per capita and physicians' fees, which disturbs a number of authors. If an increase in physicians per capita can correctly be called an increase in supply, one would normally expect such a change to lower prices and to increase the quantity supplied. Some economists explain this positive correlation observed in aggregate data with the following explanation, which centers on the individual physician. An increase in physicians per capita leads to a decrease in the demand for services per physician, which, ceteris paribus, leads to a decrease in an individual physician's income.[3] Since the new income level would be below the physician's "target," each physician, according to the argument, increases fees to bring his income up to the desired level.

---

[2] Of course, excess demand can be justified in other ways.

[3] Fuchs and Kramer (1971) find a negative correlation between the number of physicians per capita and volume of services per physician.

However, certain aspects of this theory are inconsistent with traditional microeconomic analysis. Consider figure 2.2. Initially, physicians face demand curve, D, with a corresponding marginal revenue curve, MR, and a marginal cost curve, MC. The monopolist physician will determine the optimal output level by equating marginal revenue with marginal cost, in this case providing Q units of output, and will charge a fee per unit of service of P. Reduction in the demand for services per physician shifts D to D' and MR shifts to MR' or MR". Consequently, the quantity of an individual physician's services is reduced from Q to Q' or Q" and his fees fall from P to P' or rise from P to P". Thus fees may rise independently of a physician's desire to achieve a "target" income.

Whether fees rise or fall the new income level P'Q' or P"Q" will never equal the original income PQ. Suppose a physician attempts to bring his income up to the "target" level by increasing P' or P", that is, he no longer equates marginal revenue with marginal cost, then demand for his services will fall even further from Q' or Q", respectively, due to less demand for his service at the higher price. Only by simultaneously increasing fees and increasing demand can the physician bring his income back to the "target" level. This is the basis of the "revised" targeted income theory.

Since the marginal cost curve presumably remains constant, the "revised" targeted income theory argues that while increased physicians per capita may shift the demand curve inward, physicians retaliate by forcing the demand curve back to its original position. They "create" demand by prescribing more intensive treatment per patient. However, this argument per se does not explain why the physician had not used his ability to shift demand to the fullest extent before the increase in physicians per capita.

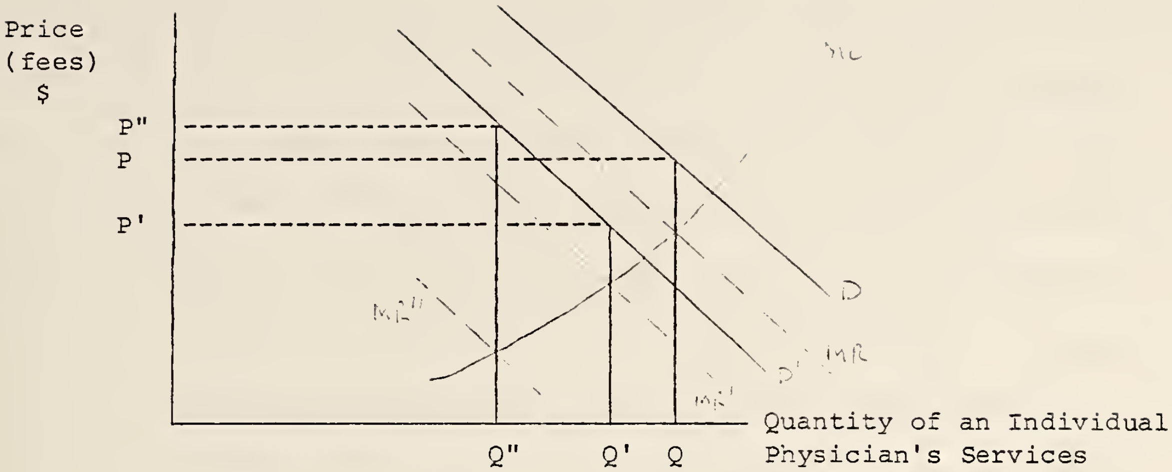

Figure 2.2: Relationship Between a Physician's Fees and the Quantity of his Services

D = exogenously determined demand curve faced by the individual physician.

D' = demand after increase in physicians per capita in the market area

MC = individual physician's marginal cost curve

P = profit-maximizing price set by monopolistic physician facing MR and MC

P' = profit-maximizing price set by monopolistic physician facing MR' and MC

P" = profit-maximizing price set by monopolistic physician facing MR" and MC

Q = quantity of services demanded with demand D at price P

Q' = quantity of services demanded with demand D' at price P'

Q" = quantity of services demanded with demand D' at price P"

Pauly and Satterthwaite (1978) discuss theories of targeted income and physician-induced demand and offer another explanation for the positive correlation between physicians' fees and physicians per capita. Their "increasing monopoly" model attempts to incorporate the positive relationship between price and supply into an orthodox income-leisure utility maximization model of physician behavior.

The "targeted income" model supposes that the supply price is a function of physicians per capita while the "increasing monopoly" model supposes that supply price is a function of physicians per information source. The Pauly and Satterthwaite model suppose that a patient will stay with his original physician as long as the utility he derives from going to this physician is higher than the expected utility of going to another physician. If the price a physician charges increases, then, ceteris paribus, some patients who were on the margin before the price rise would switch to another physician. However, if the price rise is accompanied by an increase in the number of physicians, the patient "loses" information about each of the alternative physicians which decreases the expected utility of going to an alternative physician. Consequently if both prices and the number of physicians rise, patients do not switch.

The critical element in Pauly and Satterthwaite's model is that the elasticity of demand for physicians' services is a decreasing function of the amount of information available per physician in the area. Information about a physician is provided to patients by their friends. It is a ratio of the number of friends of a ("typical") patient (N) and the number of physicians (M). Neither N or M is directly observed. Instead, the authors observe the following manifest indicators of M: the number of physicians per square mile, the fraction of the workforce that takes public transportation to work, the population density; and the following indicators of N: population growth and turnover, and the proportion of households that are headed by women.

Pauly and Satterthwaite conclude that the "increasing monopoly" model deserves serious consideration. This conclusion is based on the fact that physicians per capita is positive and significant in the "targeted income"

equation but is negative and significant in the "increasing monopoly" equation. The "increasing monopoly" model is similar to the targeted income model but it includes additional "information" variables, in particular, physicians per square mile. Also, physicians per square mile probably correlates highly with physicians per capita and, as a result, the signs of the coefficients in the increasing monopoly regression may be unstable. Consequently, Pauly and Satterthwaite's conclusion should be regarded with caution.

Bloom and Martin (undated review the literature on the pricing of physician services and stress the endogenous adjustment of workplace variables by the physician. Suppose one attempts to regulate the price of physician services in the present fee-for-service system. Bloom and Martin note that two related mechanisms are available to the physician to defeat price control. If the price of an office visit is fixed, the physician can (1) order tests and procedures and use the profit to offset relatively low office visit prices, or (2) the providers can increase utilization by changing the point at which they (providers) choose to operate within the grey zone between need and fraud (p. 30). Although standard economic analyses of physician practice decisions rarely incorporate the endogenous determination of test and procedure levels[4] the "grey zone between need and fraud" is analogous to the "creation of demand" which is addressed by several authors including Evans (1974) and Pauly and Satterthwaite (1978).

---

[4] Schroeder (1977) and Williams (1977) review this literature.

b.vi) Mark-up pricing model

Steinwald and Sloan (1974) examine the relationship of practice, physicians, patient, geographic and insurance variables on physician fees. The data are taken from a mailed questionnaire survey conducted by the A.M.A. during Fall 1971. The dependent variables in the regression analyses are fees for a follow-up visit in the office, a follow-up visit in the hospital, an appendectomy and an obstetrical delivery. The most consistent variable is the "wage" of the "standard" bundle of aides which was positive and significant in all fee equations. General practitioners over age fifty-five were found to have significantly higher fees for hospital and office visits. Patients with family incomes greater than $15,000/yr. faced higher GP fees for hospital and office visits while those patients with family incomes below $5,000/yr. were charged less (both coefficients significant at the one percent level). Interestingly, the number of physicians per 1000 population exerted a negative influence on physician fees in several equations. The percentage of the population in the physician's state covered by major medical insurance is positively related to fees and is significant in all equations.

Several features of the Sloan and Steinwald article deserve further comment. First, they present no model. They review the early physician pricing literature and suggest thatas an alternative, physicians may employ a simple "markup" method of setting fees. The standard "demand" types of variables and "markup" variables are then included in a simple regression. Second, it is difficult to interpret the wage variable. Third, the authors treat the physician's patients' characteristics as exogenous although they say, "it would be desirable to measure (patient characteristics) for the physician's market area rather than his practice." Feldstein's (1970) theory of physician pricing has, at its foundation, endogenous determination of patient-mix by the physician.

The authors conclude that "since demand variables exert a definite impact on fees, the markup-pricing mechanism theory appears to provide an inferior explanation of physician behavior." Thus, Steinwald and Sloan argue for the use of profit maximizing-type models. However, since their "demand" variables are the patient characteristics, which may be endogenously determined, and the types of insurance coverage in the state, which are generally statistically insignificant, one might suggest that markup-pricing is taking place implicitly in the selection of patients. In any case, the results do not clearly suggest the use of one type of model over another.

c) Productivity

Some of the previous analyses explicitly specify a production function for physician services. Brown and Lapan (1979), for example, specify the following production function:

$$Q = F(L,N) + Lf(n) \qquad (2.9)$$

where Q = output of physician services, L = Physician inputs, N = non-physician inputs and $n = N/L$. In this formulation $f(n)$ can be interpreted as the number of patients seen per hour by the physician -- his productivity. In this model this function is determined exclusively by the ratio of non-physician to physician inputs. However, one could consider the number of patients seen per hour as a choice variable. The only economic study that investigates the allocation of physician time per patient was conducted by Sloan and Lorant (1976).

The Sloan and Lorant paper assumes that the physician is a price-setting profit maximizer. The price of output is a function of quantity of services rendered (q), the mean length of the visit (ℓ), and the mean patient waiting time in the office (t), which are endogenous, and certain exogenous variables,

such as characteristics of patients. The physician's costs are a function of q, ℓ, t and exogenous factor prices for capital and labor. The physician behaves as if he maximizes profits.

Sloan and Lorant focus on two measures of ℓ, physicians' minutes per office visit (L_1) and full time equivalent physician minutes per office visit (L_2).[5] Both L_1 and L_2 were regressed against the exogenous demand shift and factor price variables and three standardizing variables representing various practice sizes and income-sharing arrangements. Although the explanatory variables accounted for only twelve to thirteen percent of the variance in L_1 and L_2, several variables were significant in both equations. The percentage of the physician's patients over sixty-five years old increased both L_1 and L_2 as did the percentage of patients with family incomes over $15,000/yr. Physicians board certified in their specialty and physicians with faculty appointments also spent more time per patient visit. The number of physicians per 1000 population has a positive effect on time per visit while increases in the percentage of female patients and patients under age fifteen tend to lower time per visit.

It is interesting to note that many of the significant variables could be termed patient-mix variables, an endogenous choice variable according to Feldstein. Sloan and Lorant do not discuss this possibility since they consider the patient-mix variables as exogenous sources of demand shifts. If one were seeking such demand shift variables, however, it would seem more desirable to use a level of aggregation that describes the physician's entire

---

[5] L_2 is computed by multiplying the appropriate number of hours by sixty and dividing by the number of office visits per week.

market area, not a subset of that market he has chosen to treat. (The problem is mentioned in connection with a similar study by Steinwald and Sloan (1974).)

The fact that physicians per 1000 population is positively related to time per visit adds a further complication to the theories that attempt to explain the positive correlation between the physician/population ratio and physician fees. While patients in physician-rich areas do absorb the cost of physician fee increases (as, so the argument goes, physicians strive to maintain their targeted income levels) they may also be receiving a different and perhaps higher quality product; see Newhouse (1978).

The results of the study are somewhat ambiguous because the measures of time do not reflect the type of work performed, and physician time per visit is known to vary systematically across specialties, see White (1976).

d) Production Function

Reinhardt (1972) is also interested in physician productivity. However, he concentrates on estimating a production function which relates the physician's output to hours worked and a vector of other inputs such as capital equipment and aides. Reinhardt presents a function:

$$Q_i = A \cdot \pi \left[X_{s_i}^{a_s} \cdot e^{-\beta_s X_{s_i}} \right] \exp \left[\sum_j (\gamma_j L_{ji}) - \theta (\sum_j L_{ji})^2 + \mu_i \right] \qquad (2.10)$$

where the vector X represents inputs that must be used at positive rates for output to occur and L represents inputs that need not be used at positive rates for output to occur. Reinhardt argues this form is desirable because it permits positive rates of output when no aides are employed, and it permits inputs to have both increasing and decreasing marginal products.

Output is measured alternatively by the number of office visits per week, number of total (office, hospital and home) visits per week, and total annual billings. Regression results are similar for the three specifications. Reinhardt finds the marginal product of physician time increasing up to about twenty-five hours per week and thereafter decreasing to zero which occurs at approximately one-hundred ten hours per week. The marginal product of aides increases to approximately one aide per physician, thereafter decreasing to zero between five and five and one-half aides per physician.[6]

As Reinhardt notes, however, these are estimates of technical, not economic feasibility. Reinhardt assumes the physician is a price-taker and derives the first order conditions for utility maximization of income and leisure. Assuming the physician works sixty hours a week, the observed average of 1.9 aides per physician is found to be approximately half the optimal level of that input. Reinhardt suggests that physicians employ fewer than optimal aides because they find disutility in the administrative tasks associated with the employment of aides; they trade net income for a more enjoyable practice setting.[7] This plausible argument, however, is somewhat unsatisfactory in the same sense as Feldstein's "choice of patient mix" argument. The disutility associated with the management of aides is not incorporated into the model as an explanation of observed physician behavior; it is a concept that is used to rationalize behavior which is observed, and thus one is not able to test the concept empirically in the context of the model.

---

[6] Evans (1978) summarizes the theoretical issues surrounding the use of auxiliaries in the physician's practice.

[7] An alternative explanation is that physicians do not increase the number of aides because this would result in less time spent seeing each patient and this may decrease his utility.

e) Specialty

Sloan (1970) examines lifetime earnings as a determinant of the supply of specialists versus general practitioners (family practice specialists). Sloan finds that the discounted income stream for surgeons is higher than general practitioners if a five percent discount rate is used, while the reverse is true for a ten percent discount rate. The two net present values were equal at a 5.7% discount rate in 1955. Choice of a specialty among medical school students apparently bore little relation to the present value of earnings in various specialities. Since the empirical results give little or no insight into the "virtually unanimous decisions of recent medical-school graduates against careers in general practice," Sloan suggests deficiencies that might exist in his data and the fact that the decision to specialize may be due to other factors such as intellectual stimulation and prestige. Funkenstein (1978) finds that personal characteristics of the students at the time of entry to medical school and social movements are important factors that affect this choice.

In addition, Sloan estimates two sets of regression equations: four with the number of residents in a particular specialty as the dependent variable, a fifth with the number of residents in a specialty divided by the number of residencies offered in that field in a given year as the dependent variable.[8] The coefficient on lifetime earnings is positive and significant in both sets of equations. Therefore, there is some evidence to suggest that once a doctor has decided to enter a residency program, the choice of the program depends on the expected lifetime earnings. However this effect is small.

---

[8] The $\bar{R}^2$ are between 0.96 and 0.98 in the first set of equations but this is almost certainly because "number of residencies" is an explanatory variable. In the fifth equation number of residencies is excluded from the right-hand side and the $\bar{R}^2$ drops to 0.41.

f) Geographic Location

Benham, Maurizi, and Reder (1968) examine the determinants of geographic location choices among physicians and dentists. The number of physicians in a state correlates most highly with the population in a state. Per capita income of the population is also important. Barriers to interstate migration, as measured by the percentage of applicants for licensure who fail examinations, are positively associated with the number of physicians and negatively associated with the number of dentists in the state. Benham et al. (1968), suggest that for physicians the attractiveness of a state may "cause" the higher failure rates while the lower supply of dentists in some states may be "caused" by the higher rate of failures in those states. The number of physicians per capita (but not dentists per capita) was found to be positively related to the volume of training facilities in the state. An interesting comment by Benham et al. is that physicians per capita may be endogenous in a physician's price or income equation not only through the migration of physicians to attractive areas, but also through the intervening influence of state examining boards.[9]

---

9. The subject of medical certification is discussed in this and other contexts in Stone (1977).

which is analagous to a budget constraint in this example. In other models the constraints may be analagous to production possibility frontiers. The model becomes

$$\max U(y,Q) \qquad (3.1)$$

$$\text{s.t. } y = f(Q) \qquad (3.2)$$

where $\partial y/\partial Q < 0$. Now suppose there are two types of "respresentative" physicians whose utility functions, U_1 and U_2, are drawn in Figure 3.1. In this case we would observe two types of physicians: (a) income preferring physicians who have high income and few leisure hours and (b) leisure preferring physicians who have low incomes but many leisure hours.

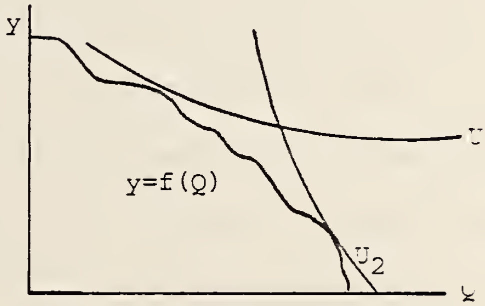

Figure 3.1: Hypothetical Physician Utility Functions

This simple example considers only two dimensions of the practices. In addition to income and leisure, legitimate arguments of the utility function include productivity, aides and patients' characteristics. Clearly, it is appropriate to allow for many types of physicians.

Of course, a physician does not have unrestricted control over all practice attributes. For example, a physician cannot work few hours, see few patients, have low fees and have a high net income from the medical practice. There are limits to the number of patients a physician can see per hour, the number of hours he can work per day, and the number of aides he can supervise

3. PHYSICIANS' PRACTICE STYLES

a) Introduction

In reviewing the literature on decisions made by physicians concerning their practice it becomes apparent that traditional economic models leave much to be desired. Profit-maximizing, price-taking firms would be expected to increase output as long as marginal net profits were positive, but physicians display a wide variance in their level of services supplied. One might argue that profits should reflect an imputed wage for the physician's valuation of his own time inputs, or that the practice should be modeled as a utility maximizing entity with preferences for income and leisure. However, neither of these models accounts for the observed slack in the physician's discretionary power over patient mix or number of aides, for example, both of which could be varied to maximize unit prices or wages. To incorporate such decision variables into a standard utility maximizing framework is very complicated and calls for an alternative approach.

Our approach recognises that a physician makes many choices regarding his practice. First, he may choose a specialty during the course of his medical training. Upon graduation he decides among alternative geographic locations and sizes of practice. He may also wish to become board certified. A physician usually makes these choices early in his career. Once his practice is established, however, there are still many other choice variables over which the physician exercises considerable discretion.

In our present health care delivery system physicians are the gatekeepers of virtually every type of health care-related resource. This gatekeeper role is evidenced by physicians' economic success, and by society's

profound trust in their capabilities and integrity. Societal trust in the physicians' decisions results in a special relationship between physicians and their patients. Furthermore, it allows physicians' discretionary latitude in determining the form of their production function (including what type of treatment is prescribed) and to some extent, the price of factors of production and hence the cost of output.

Additional, physicians have control over variables which are often the focus of microeconomic inquiry into physician behavior, namely income and leisure. Net income, hours spent seeing patients, hours spent on administrative tasks, and hours spent on teaching, research and other professional activities are important characteristics of the practice. The economic literature also discusses physician productivity (number of patients seen per unit time), use of aides and fee for service. Finally, as Feldstein (1970) suggests, physicians care about their patient mix. All these practice attribute variables characterize the style of practice.

We divide the variables into three groups:

i) Practice attribute variables. In our empirical analyses we include in this group the following variables:

a) number of hours worked by aides per physician in the practice,
b) physician's net income from the practice,
c) physician's level of fees,
d) mix of patients seen by the physician, e.g. the patients' demographics and types of insurance coverage,
e) number of patients seen per unit time by the physician,
f) division of the physician's time across various activities.

ii) Early career choice variables. These include type of specialty, whether or not the physician is board certified, size of practice (the number of physicians in the practice) and geographic location.

iii) Exogenous variables. These include the physician's race, sex, years of experience, and income from sources outside the practice.

Thus, variables are grouped according to the ease with which a physician can vary them. The first group of variables are relatively easy to change at any time, the second group of variables are relatively hard to change soon after the physician has graduated from medical school, and the third group of variables are fixed at any point in time.

Our primary concern is the variables in the first group. The following discussion suggests three major simultaneous influences on the practice attribute variables: supply influences on the part of physicians, technological constraints among the attributes themselves and demand influences by patients.

Consider first the supply influences and physicians' preferences. When discussing preferences for a bundle of commodities such as practice attribute variables it is useful to refer to the concept of a utility function that yields a value of "satisfaction" the individual derives from each bundle of commodities. Suppose that a physician's utility depends on income, y, and characteristics of the work environment, $\underset{\sim}{v}$. While, in practice, $\underset{\sim}{v}$ will be multidimensional, let us consider only the leisure dimension. All physicians maximize their utility subject to a negative relationship between y and $\underset{\sim}{v}$,

effectively. These technological constraints apply to all physicians and limit the number of types of behavior.

Whatever the particular set of attributes of a physician's practice may be, consumers of physicians' services have preferences over this set. If patients find a particular type of practice "unsatisfactory" they will, no doubt, seek an alternative type. Clearly, different patients have different needs and different utility functions. For example, elderly patients with chronic illness may have quite different preferences from poor patients with recurrent, acute illnesses. These different preferences generate different demands for certain attributes of the physician's practice.

Just as a physician has a preference for a certain type of practice and type of patients, a patient has a preference for a certain type of practice. There is a "matching" between the needs and preferences of physicians and patients. The net effect of this matching process -- individual physician with individual patient -- is to create a number of what we refer to as equilibrium "styles" of practice. Since there are many practice attributes and since physicians' preferences differ and patients' preferences differ more than one type of style will be identified. Technological constraints, however, limit the number of styles.

The styles are determined as a result of aggregate physician and patient behavior. We propose first to identify the styles by performing factor analyses on the practice attributes variables. These results are presented in Tables 3.3 through 3.9. Tables 3.6 and 3.9 are the most important tables. Tables 3.5, 3.6 and 3.7 contain varimax rotated factor matrices for twelve variables that characterize the physician's practice and can conceivably be

changed on a relatively short-run basis. Table 3.10 contains the varimax rotated factor matrix of the same variables as in Table 3.6 and, in addition, certain variables over which the physician has control and the exercises choice, but only in the long run, or prior to choosing the twelve practice attribute variables. These additional variables include type of specialty and characteristics of the geographic region in which the physician lives.

The second task is to investigate the determinants of these styles. We do this in two separate analyses. The first, preliminary analysis includes exogenous personal characteristics of the physician in the factor analyses. These exogenous variables are amount of income from outside the medical practice (OVER10), the physician's race (WHITE), sex (MALE) and years of experience (EXPER).[10] In Table 3.11 we present a varimax rotated factor matrix for the variables that appear in Table 3.6 plus the exogenous variables. In Table 3.13 we analyze the variables in Table 3.10 plus the exogenous variables. The purpose of this analysis is two-fold: (1) to determine the stability of the practice styles when the exogenous variables are added and (2) to gain preliminary insight into the effects of the exogenous variables. The second analysis treats the parameters of the styles as relatively fixed, and examines the adoption of a particular style by a particular physician. For this latter purpose we postulate and estimate, by maximum likelihood methods, preliminary causal models. The results are presented in Table 3.14 and 3.15.

---

10. Age was not used because it was too highly correlated with experience (r = 0.892). When both variables were included in the analysis a factor of these two variables alone was always produced. Of these two characteristics of the physician, experience was thought to bear most directly on the organization of the practice.

The analyses in this section are exploratory, and are based exclusively on the 1975 data. A similar but independentlt datatest was collected in 1976. This dataset is used exclusively for confirmatory purposes; these results are presented in chapter four.

b) Review of Factor Analysis

We first attempt to identify practice styles by performing factor analyses on the attributes which characterize the physician's practice. If underlying styles of practice exist then it should be possible to identify these underlying styles in the correlation matrix of the practice attributes. In other words, it should be possible to reduce the practice attributes to a smaller number of attribute combinations which represent a more parsimonious explanation of practice styles.

The factor analysis model can be written as follows:[11]

$$y = \Lambda_y \eta + \varepsilon \qquad (3.3)$$

where y (p x 1) is a vector of p observed attributes of the practice, Λ_y (p x m) is a matrix of factor loadings, η (m x 1) is a vector of m unobserved styles of practice (common-factor variates) and ε (p x 1) is a vector of specific factor variates (error). y and η are standardized to have zero mean and η to have unit variance. Each element of ε is distributed independently with mean zero. In addition, the variance-covariance matrix of ε , θ_ε is assumed to be diagonal. The variance of the ith element of y can be written as:

---

[11] The following discussion follows a more complete explanation of factor analytic methods found in Morrison (1976).

$$\sigma_i^2 = \lambda_{yi1}^2 + \ldots + \lambda_{yim}^2 + \theta_{\varepsilon i} \qquad (3.4)$$

and the covariance between y_i and y_j:

$$\sigma_{ij} = \lambda_{i1}\lambda_{j1} + \ldots + \lambda_{im}\lambda_{jm} \qquad (3.5)$$

or in matrix format:

$$\Sigma = \Lambda_y\Lambda_y' + \theta_\varepsilon \qquad (3.6)$$

where Σ is the variance-covariance of y.

Re-writing equation (2) as:

$$\sigma_i^2 - \theta_{\varepsilon_i} = \sum_{j=1}^{m} \lambda_{yij}^2 \qquad (3.7)$$

we can express the "communalities" of the y's. Also:

$$\text{Covariance } (y, \eta') = E\left[(\Lambda_y \eta + \varepsilon)\eta'\right] \qquad (3.8)$$

The purpose of factor analysis is to estimates the elements of Λ_y.

In our analyses, many of our variables were highly correlated. This correlation results in a determinant of Σ which is very close to zero, and this is problematic in some factor analytic methods because the determinant enters the estimation equation(s) in the denominator. To circumvent this problem the principal components method was used to extract factors from the correlation matrix. Principal components have the desirable property of explaining the maximum possible amount of variance in the data. Principal components differ from other factor analytic methods in that the communalities are assumed to equal 1.0 and are not replaced with estimated communalities as the factors are extracted. Principal components themselves are not thought of as hypotheses to be tested statistically, they are simply linear combinations of variables which possess specific mathematical properties. There are,

however, several measures by which one can judge the efficacy of the factors. First, the more variance in the data explained by a small number of factors, the better. Secondly, the percent of each variable's variance explained by the factors should be as high as possible.

The purpose of the factor analyses is to identify a simplified set of relationships among many endogenous choice variables. Thus we frequently rotate the factors to simplify the columns of the factor matrix which represent the styles of practice. Simplification in this case is defined as a column with variable loadings of 1.0 or 0. This criteria for a simple structure is met by maximizing the variance of the squared loadings (variance of Λ_y^2) in each column, and is achieved by a rotation known as varimax. This rotation does not affect the factors' ability to reproduce the observed correlation matrix, but the rotated factor loading matrix no longer represents that unique set of coefficients which explains the maximum variance in the data. For orthogonal rotations such as varimax, these communalities represent the amount of variance in each variable explained by all the rotated factors.

c) Identification of Practice Styles

The variables for the 1975 data are described in Table 3.1 and the means and standard deviations are presented in Table 3.2. The factor analyses were based on 460 observations for which there was no missing value for any variable. We did not make use of the imputed values version of the 1975 tape.

First we performed our analyses using the practice attribute variables. In other words we include only those variables that can be altered after the establishment of the practice. The percentage of total variance explained by each of the factors appears in Table 3.3 and the unrotated factor matrix in Table 3.4. In Tables 3.5, 3.6 and 3.7 we present the varimax rotated factor matrices for the first four, five and six factors, respectively, and also present the communalities. Second we break down the number of hours spent seeing patients and the number of patients seen per week into three separate "settings": the office, hospital, and "other" locations. These results are reported in Table 3.8, which is included to see whether significant explanatory power, in the conceptual sense, is lost by considering only total patients and total hours, rather than breaking these variables down into their separate components.

Third, we add to the practice attributes, variables whose values are determined during the establishment of the practice. These early career choice variables are specialty (FAMGP, SURGERY, PEDTRCS, OBGYN and INTRNST), board certification (BCERT), number of physicians in the practice (SIZE) and characteristics of the physician's geographic location. The four indicators of geographic location are average per-capita income in the physician's county in 1970 (CNTYINC), physicians per capita in 1975 (PHYSPOP), physicians per square mile in 1975 (PHYSSQM) and percent of population over age sixty-five in 1970 (AGED). Per capita income and population over age sixty-five were included as proxies for demand for physician services in the market area. Physicians per square mile was intended to represent supply of physician services and physicians per capita could be an indicator of either supply or demand shift. Population per square mile would have been a desirable indicator of urban/rural, but was not included because of its high zero-order

correlation (r = .9513) with physicians per square mile. Table 3.9 presents the amount of variance explained by each factor and Table 3.10 contains the varimax rotations of the first eight factors. If we were interested in examining only the attributes of a physician's practice that can be changed on a more or less day to day basis we would restrict the analysis, and would consider the additional variables that appear in 3.9 as exogenous. It was of interest to us at this stage, however, to determine whether the addition of these variables affected the identifiable practice styles.

These analyses are exploratory. The purpose is to investigate whether certain styles of physician practice exist, and, if so, to determine thier number and to describe them. Choosing the number of factors is not a simple task and, in the absence of definite a priori guidelines, the criteria for selecting the number of factors is the subject of some debate in the factor analysist literature. One criterion on which there seems to be general agreement is to include those factors with eigenvalues greater than unity. The eigenvalues of the correlation matrix represent the amount of variance in all the variables explained by particular factors. Choosing these factors with eigenvalues greater than unity assures the inclusion of all factors which explain as much variance in the attributes as any single variable. The eigenvalues for the correlation matrix of practice attributes in the 1975 data are shown in Table 3.3. The first five factors have eigenvalues which are greater than or equal to one. Also shown in Table 3.3 is the percent of variance in the practice attribute variables explained by each factor. The first five variables taken together explain 61.1 percent of the toal variance.

Tables 3.5 through 3.7 present the results of performing a varimax rotation on the first four, five and six factors, respectively. Table 3.5 clearly identifies four "styles" but non-medical hours and professional hours does not load on any factor. Table 3.6 is similar to Table 3.5: the first four factors are very similar but now non-medical and professional hours load on a fifth factor. In Table 3.7 the first four factors are again present but NONMHRS and PROFHRS load on separate factors. This latter separation is not of significant interest and the eigenvalue of the sixth factor is less than unity, which is the usual cut-off value.

Apart from small variations, Tables 3.5 through 3.10 identify five practice styles:

(i) Busy, successful, ambulatory care practice. This style includes physicians who use many aides, see many patients, work long hours seeing patients and have high net incomes. See Table 3.5 - factor1 (abbreviated to T3.5-F1), T3.6-F1, T3.7-F1, T3.8-F1 and T3.10-F3. Table 3.8-F1 suggests that these physicians see most of their patients in the office rather than in hospitals or in other settings.

(ii) Low-income practice. This style includes physicians who treat low income patients and Medicaid patients; see T3.5-F2, T3.6-F2, T3.7-F2, T3.8-F3 and T3.10-F5.

(iii) Expensive, prosperous practice. This style includes physicians who charge high fees, see high income patients and have reasonably high net incomes; see T3.5-F3, T3.6-F3, T3.7-F3 and T3.8-F5. In Table 3.10 the variables do not have very high loadings on a single factor, but have moderate

Table 3.1: Variables' Description (1975 Data)

Variable	Survey Question Number	Definition
AGED		Proportion of population over age 65 (1970)
AIDHRMD		Total number of hours per week worked by all aides divided by the number of physicians (SIZE)
AIDPRMD	67,6	The number of non-physician employees in the practice divided by the number of physicians (SIZE)
BCERT	487 (on coding form)	Primary specialty boards; yes=1, otherwise = 0
BLKPAT	21b	Percent of the physician's patients who are black
CNTYINC		Average per capita income in the county (1970)
EXPER[a]	483 (on coding form)	Experience; 1975 minus the year the physician was licensed
FAMGP	1a	General/Family Practice Specialty
FEEOFF[b,c]	2 (insurance form)	Physician's current usual fee for a follow-up visit in the office
HIINC	21c	Percentage of the physician's patients who have high family incomes
HOSHRS	26	Hours spent on hospital rounds
INTRNST	1a	Internal Medicine Specialty

---

[a] Age was not used because it was too highly correlated with experience (r=0.892). When both variables were included in the analysis a factor of these two variables alone was always produced by rotation. Of these two personal characteristics of the physician, experience was thought to bear most directly on the organization of the practice.

[b] The variable FEEOFF was chosen to represent fees since FEEOFF had the fewest missing values.

[c] NETINC and FEEOFF were standardized by the cost of living variable found in columns 4908 to 4916.

Table 3.1: 1975 Variables (cont.)

Variable	Survey Question Number	Definition
LOWINC	21d	Percentage of the physician's patients who have low family income
MALE	336 (on coding form)	Physician's sex; male=1, female=0
MDCAID	1c (on insurance form)	Percentage of physician's patients who are covered by Medicaid
MDCARE	1d (on insurance form)	Percentage of physician's patients who are covered by Medicare
MEDHRS		HOSHRS + OFFHRS + OTRHRS
NETINC[d]	63	Physician's net income from the practice in 1975
NOHOS	27	Number of patients seen on hospital rounds
NOINS	1a (on insurance form)	Percentage of the physician's patients who have no insurance
NONMHRS	36	Total hours during previous seven days spent on: 1) filling out health insurance forms 2) billing patients 3) personnel matters 4) general financial matters 5) administrative matters related to the hospital and 6) administrative matters related to the physician's own practice
NOOFF	23	Number of patients seen in the office in the last seven days
NOOTR	24, 29, 30, 33	Sum of the number of patients seen on house calls, in emergency rooms or outpatient clinics, nursing homes and number of operations and assists in the last seven days

---

a. NETINC and FEEOFF were standardized by the cost of living variable found in columns 4908 to 4916.

Table 3.1: 1975 Variables (cont.)

Variable	Survey Question Number	Definition
NUMBER[e]		NOHOS + NOOFF + NOOTR
OBGYN	1a	Obstetrics/Gynecology Specialty
OFFHRS	22	Number of office hours spent seeing patients in previous seven days
OTRHRS	25, 28, 31, 32	Number of hours spent seeing patients on housecalls, in emergency rooms or outpatient clinics, nursing homes and on operations and assists in last seven days
OVER10	65	The physician and spouse have income from outside the medical practice in excess of $10,000 = 1, otherwise = 0
PEDTRCS	1a	Pediatrics Specialty
PHYSPOP		Physicians per 100 population (1975)
PHYSSQM		Physicians per square mile (1975)
PROFHRS	34	Number of hours devoted to other professional activities such as professional reading, writing, research, teaching and medical meetings in the last seven days
SIZE	6	Number of physicians associated with the office at least 20 hours a week
SURGERY		General Surgery Specialty
WHITE	337 (on coding form)	Physician's race; white = 1, non-white = 0

---

[e] Number of patients per unit time is unquestionably an important variable which characterizes the physician's practice. NUMBER ÷ MEDHRS would be one measure of patients per unit time but, unfortunately, there was little variance in MEDHRS in the 1975 data, leading to a high correlation (r=.800) of MEDHRS and (NUMBER ÷ MEDHRS). Thus NUMBER, number of patients per week, was used as a measure of patients per unit time in 1975 factor analyses.

Table 3.2: Means and Standard Deviations (1975 Data)

VARIABLE	MEAN	STANDARD DEV
AIDHRMD	69.27	46.34
AIDPRMD	2.39	1.56
NETINC	54901.74	28761.02
FEEOFF	12.31	4.37
HIINC	18.20	18.56
LOWINC	22.53	21.22
NOINS	12.87	16.17
MDCARE	23.37	20.40
MDCAID	11.56	14.98
NUMBER	163.97	84.56
MEDHRS	51.68	16.86
NOHOS	41.80	40.76
NOOFF	109.44	71.80
NOOTR	12.72	18.80
HOSHRS	12.68	8.68
OFFHRS	29.14	11.54
OTRHRS	9.86	10.91
NONMHRS	6.42	6.42
PROFHRS	8.32	6.02
FAMGP	0.34	0.47
SURGERY	0.15	0.36
PEDTRCS	0.13	0.34
OBGYN	0.14	0.35
INTRNST	0.24	0.43
BCERT	0.45	0.50
SIZE	1.84	1.71
CNTYINC	4514.12	838.64
PHYSSQM	17.84	77.20
PHYSPOP	0.21	0.14
AGED	0.09	0.02
OVER10	0.19	0.39
WHITE	0.95	0.22
MALE	0.93	0.25
EXPER	22.70	11.73

loadings on factors 1 and 6. T3.10-F1 shows that there may be a group of board certified internists who work in a large, moderately expensive, prosperous practices. Family-general practitioners have a large negative loading on this style. Table 3.10-F6 suggests a group of gynecologists or obstetricians who have moderately expersive , prosperous practices. A final note is that in all tables number of patients is negatively related to this style which suggests these physicians see fewer patients than average.

(iv) Geriatric, hospital practice. This style includes physicians who treat Medicare patients and patients with insurance, see T3.5-F4, T3.6-F4, T3.7-F4, T3.8-F2 and T3.10-F2. Table 3.8 suggests that these physicians see many patients and work long hours in hospitals rather than in the office or in other settings, and Table 3.10 suggests that they are most likely to be internists and least like to be pediatricians.

(v) Academic or administrative practice. This style includes physicians who work many non-medical hours (administration) and many hours in other professional tasks, such as teaching and research; see T3.6-F5, T3.8-F6 and T3.10-F7. Table 3.10 suggests that these physicians are most likely to be found in urban areas.

d) Preliminarly Analysis of the Determinants of Practice Style

This section examines the relationships between the styles we identified in the previous section and certain exogenous characteristics of the physician, notably physician's race (WHITE), experience (EXPER), whether he has over $10,000 outside income (OVER 10) and sex (MALE).

The previous factor analyses (Tables 3.7 and 3.10 are repeated with the addition of the exogenous variables. These results are reported in Tables 3.11 and 3.13, respectively. The major purpose is to ensure that the physician "styles" are robust and are still identifiable when additional variables are added. Another purpose is to find out which explanatory variables load on each practice "style".

First, note that the practice "styles" are clearly robust. We now discuss each of the styles and the exogenous variables that load on each style:

(i) Busy, successful, ambulatory care practice. The variable indicating the physician's sex (MALE) loads highly on this style in Table 3.11 factor 1 (T3.11-F1) and moderately in T3.13-F4. Experience has a moderate negative loading.

(ii) Low-income practice. In T3.11-F2 and T3.13-F5, the variables for physician's race (WHITE) has high negative loadings. This suggests that a minority physician is more likely than a white physician to focus on treating low-income Medicaid patients.[12] It does not mean, however, that low-income Medicaid patients are more likely to be treated by a minority physician because most of the physicians in the sample are white.

(iii) Expensive, prosperous practice. In T3.11-F3 the variable OVER10, which indicates more than $10,000 in outside income, has a high loading. In

---

[12] Of course, minority physicians may have less choice than white physicians and may be imposed upon to treat low income, Medicaid patients by racial discrimination from patients and other physicians.

Table 3.13, as in Table 3.10, style (iii) appears as two factors, but no exogenous variables loads on either of them.

(iv) Geriatric, hospital practice. No exogenous variable loads highly on this style.[13]

(v) Academic or Administrative practice. In T3.11-F6 no exogenous variable has a high loading on this style. In Table 3.13 the variables NONMHRS and PROFHRS load on different factors. Low non-medical hours seem to be associated with experienced physicians who earn more than $10,000 from sources outside the practice. Large numbers of other professional hours are associated with male physicians and, to some extent, those who see high income patients.

In summary, MALE loads reasonably highly on style (i), and minority (non-white) loads on style (ii). Over $10,000 outside income has a high loading on style (iii), but only in Table 3.11, and experience does not have a particularly high loading, either positive or negative, on any style. This suggests two hypotheses. The first is that physicians do not dramatically alter their style of practice during the course of their medical career. The second is that there have not been dramatic shifts in the distribution of physicians across states in the period covered by the physicians in the sample.

---

[13] In Table 3.11 the signs of MDCARE and NOINS are reversed, but the factor may be interpreted as the same style identified in other tables. See the discussion of style (iii) in the previous section.

Table 3.3: Percentage of Variance Explained by Each Factor (Practice Attribute Variables Only)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	1.967	16.4	16.4
2	1.637	13.6	30.0
3	1.346	11.2	41.3
4	1.177	9.8	51.1
5	1.097	9.1	60.2
6	0.888	7.4	67.6
7	0.825	6.9	74.5
8	0.770	6.4	80.9
9	0.712	5.9	86.8
10	0.583	4.9	91.7
11	0.525	4.4	96.1
12	0.472	3.9	100.0

Table 3.4: Unrotated Factor Matrix (Practice Attribute Variables Only)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
AIDPRMD	0.598	0.300	-0.101	0.085	0.015	-0.227	0.143
NETINC	0.486	0.525	0.072	0.167	-0.229	0.045	0.288
FEEOFF	-0.090	0.507	0.387	0.488	-0.166	0.176	0.250
HIINC	-0.286	0.485	0.068	0.368	0.046	0.188	-0.626
LOWINC	0.376	-0.553	0.386	0.351	-0.020	0.037	-0.122
NOINS	-0.003	-0.171	-0.564	0.417	0.302	0.180	0.198
MDCARE	-0.186	0.138	0.531	-0.507	-0.133	0.044	0.125
MDCAID	0.299	-0.588	0.448	0.293	-0.155	0.016	-0.029
NUMBER	0.783	0.064	-0.123	-0.140	0.181	-0.044	-0.093
MEDHRS	0.613	0.216	0.119	-0.255	0.212	0.193	-0.353
NONMHRS	-0.071	-0.001	0.318	-0.082	0.730	0.443	0.251
PROFHRS	-0.172	0.170	0.311	0.191	0.521	-0.705	-0.014

Table 3.5: Varimax Rotated Factor Matrix (4 factors)[a]

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	COMMUNALITY
AIDPRMD	0.662	0.001	0.048	-0.156	0.465
NETINC	0.657	-0.067	0.330	-0.031	0.545
FEEOFF	0.114	0.033	0.796	0.078	0.653
HIINC	-0.065	-0.233	0.626	-0.077	0.457
LOWINC	0.063	0.841	-0.032	-0.027	0.714
NOINS	-0.106	0.009	-0.042	-0.713	0.521
MDCARE	-0.073	-0.110	-0.003	0.759	0.593
MDCAID	-0.011	0.846	-0.050	0.058	0.721
NUMBER	0.738	0.116	-0.295	-0.087	0.652
MEDHRS	0.665	0.026	-0.146	0.209	0.502
NONMHRS	-0.058	0.099	0.086	0.303	0.113
PROFHRS	-0.090	0.062	0.391	0.165	0.192
STYLES	(i)	(ii)	(iii)	(iv)	

Table 3.6: Varimax Rotated Factor Matrix (5 factors)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	COMMUNALITY
AIDPRMD	0.653	0.002	0.124	-0.123	-0.092	0.466
NETINC	0.590	-0.025	0.442	0.070	-0.221	0.598
FEEOFF	0.024	0.070	0.812	0.116	0.041	0.680
HIINC	-0.112	-0.230	0.606	-0.083	0.138	0.459
LOWINC	0.070	0.835	-0.054	-0.072	0.055	0.714
NOINS	-0.057	-0.051	-0.072	-0.773	0.060	0.612
MDCARE	-0.095	-0.073	-0.023	0.765	0.105	0.611
MDCAID	-0.019	0.859	-0.057	0.047	-0.038	0.745
NUMBER	0.779	0.091	-0.242	-0.107	0.010	0.685
MEDHRS	0.692	0.007	-0.126	0.165	0.160	0.547
NONMHRS	0.031	0.009	-0.090	0.058	0.795	0.645
PROFHRS	-0.053	0.001	0.253	-0.014	0.629	0.463
STYLES	(i)	(ii)	(iii)	(iv)	(v)	

---

[a] In this and subsequent rotated factor loading tables, loadings greater than .4 in absolute value are underlined.

Table 3.7: Varimax Rotated Factor Matrix (6 factors)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
AIDPRMD	0.669	-0.005	0.055	-0.101	-0.194	0.136
NETINC	0.598	-0.024	0.432	0.071	-0.201	-0.099
FEEOFF	0.025	0.078	0.831	0.108	0.012	0.042
HIINC	-0.116	-0.222	0.640	-0.094	0.100	0.059
LOWINC	0.068	0.836	-0.050	-0.074	0.057	0.012
NOINS	-0.065	-0.046	-0.029	-0.787	0.118	-0.069
MDCARE	-0.104	-0.071	0.004	0.757	0.150	-0.028
MDCAID	-0.018	0.859	-0.061	0.047	-0.028	-0.030
NUMBER	0.777	0.089	-0.246	-0.105	0.061	-0.027
MEDHRS	0.673	0.013	-0.060	0.146	0.302	-0.121
NONMHRS	-0.012	0.026	0.059	0.015	0.910	0.087
PROFHRS	-0.022	-0.018	0.074	0.046	0.082	0.972
STYLES	(i)	(ii)	(iii)	(iv)	(v)	(v)

VARIABLE	COMMUNALITY
AIDPRMD	0.517
NETINC	0.600
FEEOFF	0.712
HIINC	0.494
LOWINC	0.715
NOINS	0.645
MDCARE	0.612
MDCAID	0.745
NUMBER	0.687
MEDHRS	0.584
NONMHRS	0.841
PROFHRS	0.960

Table 3.8: Varimax Rotated Factor Matrix (6 factors) Including Separately Hours and Patients Seen in Office, Hospital and Elsewhere

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
AIDPRMD	0.705	0.131	0.043	-0.005	0.144	-0.060
NETINC	0.451	0.193	-0.064	0.275	0.511	-0.223
FEEOFF	-0.061	0.088	0.067	-0.049	0.814	0.028
HIINC	-0.112	-0.153	-0.227	-0.075	0.575	0.168
LOWINC	0.095	-0.027	0.817	0.093	-0.048	0.087
NOINS	0.142	-0.593	-0.124	0.074	-0.069	0.204
MDCARE	-0.283	0.633	-0.013	-0.127	-0.062	0.001
MDCAID	-0.033	0.013	0.840	0.118	-0.052	-0.031
NOHOS	0.204	0.639	-0.058	0.357	0.040	0.184
NOOFF	0.764	-0.200	0.057	-0.050	-0.192	-0.046
NOOTR	-0.052	-0.006	0.222	0.748	-0.163	-0.001
HOSHRS	0.147	0.654	-0.132	0.288	0.005	0.337
OFHRS	0.683	-0.207	-0.020	-0.272	-0.167	0.042
OTRHRS	-0.166	0.087	0.054	0.842	0.086	-0.070
NONMHRS	-0.050	-0.012	-0.000	0.086	-0.061	0.740
PROFHRS	-0.055	0.086	0.070	-0.201	0.219	0.597
STYLES	(i)	(iv)	(ii)		(iii)	(v)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	2.390	14.9	14.9
2	1.958	12.2	27.2
3	1.795	11.2	38.4
4	1.243	7.8	46.2
5	1.209	7.6	53.7
6	1.050	6.6	60.3
7	0.941	5.9	66.2
8	0.871	5.4	71.6
9	0.833	5.2	76.8
10	0.759	4.7	81.6
11	0.624	3.9	85.5
12	0.584	3.7	89.1
13	0.517	3.2	92.3
14	0.445	2.8	95.1
15	0.418	2.6	97.7
16	0.363	2.3	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.541
NETINC	0.632
FEEOFF	0.682
HIINC	0.452
LOWINC	0.696
NOINS	0.439
MDCARE	0.501
MDCAID	0.724
NOHOS	0.615
NOOFF	0.668
NOOTR	0.638
HOSHRS	0.663
OFHRS	0.614
OTRHRS	0.760
NONMHRS	0.561
PROFHRS	0.460

Table 3.9: Percentage of Variance Explained by Each Factor (Practice Attribute and Early Career Choice Variables)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	2.807	12.2	12.2
2	2.393	10.4	22.6
3	2.069	9.0	31.6
4	1.635	7.1	38.7
5	1.567	6.8	45.5
6	1.284	5.6	51.1
7	1.243	5.4	56.5
8	1.185	5.2	61.7
9	0.984	4.3	66.0
10	0.917	4.0	69.9
11	0.881	3.8	73.8
12	0.848	3.7	77.5
13	0.776	3.4	80.8
14	0.733	3.2	84.0
15	0.637	2.8	86.8
16	0.581	2.5	89.3
17	0.518	2.3	91.6
18	0.509	2.2	93.8
19	0.418	1.8	95.6
20	0.395	1.7	97.3
21	0.373	1.6	98.9
22	0.246	1.1	100.0
23	0.000	0.0	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.536
NETINC	0.532
FEEOFF	0.582
HIINC	0.317
LOWINC	0.722
NOINS	0.380
MDCARE	0.689
MDCAID	0.737
NUMBER	0.675
MEDHRS	0.517
NONMHRS	0.249
PROFHRS	0.251
FAMGP	0.765
SURGERY	0.809
PEDTRCS	0.821
OBGYN	0.797
INTRNST	0.825
BCERT	0.624
SIZE	0.404
CNTYINC	0.664
PHYSSQM	0.777
PHYSPOP	0.768
AGED	0.744

Table 3.10: Varimax Rotated Factor Matrix (Practice Attributes and Early Career Choice Variables)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
AIDPRMD	0.070	-0.032	0.635	-0.072	0.017	-0.030	-0.068	0.340
NETINC	0.312	0.056	0.578	0.002	-0.061	0.273	-0.050	-0.130
FEEOFF	0.317	0.233	0.053	-0.002	0.013	0.591	0.264	0.074
HIINC	0.283	0.080	-0.090	0.018	-0.269	0.219	0.230	0.219
LOWINC	-0.064	0.002	0.080	0.083	0.837	0.040	-0.040	0.029
NOINS	-0.133	-0.452	-0.052	0.285	-0.058	0.007	-0.120	0.238
MDCARE	-0.088	0.805	-0.047	0.032	-0.048	-0.155	0.033	-0.046
MDCAID	-0.011	-0.025	-0.019	-0.065	0.851	-0.048	-0.006	-0.072
NUMBER	-0.122	-0.179	0.761	-0.087	0.109	-0.148	-0.055	0.071
MEDHRS	-0.046	0.080	0.692	-0.048	0.014	0.031	0.025	-0.160
NONMHRS	-0.103	0.120	0.118	0.145	-0.010	-0.087	0.384	-0.184
PROFHRS	0.020	0.080	0.029	0.036	-0.044	-0.030	0.488	0.030
FAMGP	-0.823	0.014	0.121	-0.001	0.007	-0.182	-0.099	0.169
SURGERY	0.183	0.123	-0.036	-0.008	0.056	-0.048	-0.005	-0.868
PEDTRCS	0.361	-0.718	0.001	-0.012	0.019	-0.377	0.145	0.107
OBGYN	0.046	-0.227	-0.013	-0.015	-0.027	0.841	-0.136	0.005
INTRNST	0.427	0.635	-0.094	0.030	-0.048	-0.123	0.143	0.437
BCERT	0.737	-0.123	0.066	0.002	-0.086	0.065	-0.007	-0.224
SIZE	0.543	0.028	0.118	0.041	-0.006	-0.012	-0.191	0.237
CNTYINC	0.003	-0.131	-0.251	-0.049	-0.010	0.062	0.759	0.047
PHYSSQM	-0.034	-0.081	-0.104	0.697	0.052	0.054	0.515	0.024
PHYSPOP	0.165	-0.082	-0.137	0.713	0.040	0.093	0.440	0.058
AGED	-0.008	0.041	-0.039	0.832	-0.028	-0.094	-0.189	-0.054
STYLES	(iii)	(iv)	(i)		(ii)	(iii)	(v)	

Over $10,000 outside income, race and experience tend to load highly on the same factor T3.11-F4 and T3.13-F8. The signs of these loadings indicate that younger minority physicians have less outside household income than older white physicians. Possibly this finding is due to the greater investment income for the older white physicians.

The coefficients for specialty (Table 3.13 only) suggest that family practice-general practitioners are less likely than any other specialists to adopt style (i), surgeons do not load highly on any style, pediatricians have a low loading on style (iii), while obstetricians-gynecologists load highly on this style, and internists have a high loading on style (iv).

Board certification and size load on T3.13-F2 which is similar to style (iii). The geographic variables load on T3.13-F1 and T3.13-F9, but not on any particular style.

e) A Causal Model of Physicians' Styles

e.i) Introduction

Practice attribute variables are linked by a complex set of relationships. The concept of styles serves to reduce the degree of complexity to a more manageable level by identifying various forms of physician behaviour which generate the observed data. Conceptually, the styles can be regarded as latent variables, with observed practice attributes as manifest indicators. In other words "styles" make conceptual sense but they are not directly observed just as, for example, verbal or mathematical ability are unobserved. The practice attribute variables are indicators of the various styles just as scores on various tests are indicators of veral or

Table 3.11: Variance Rotated Factor Matrix (Practice Attribute and Exogenous Variables)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
AIDPRMD	0.641	-0.050	0.134	-0.070	-0.079	-0.129
NETINC	0.617	-0.087	0.408	-0.053	0.007	-0.218
FEEOFF	0.042	-0.010	0.757	-0.062	0.075	0.078
HIINC	-0.081	-0.223	0.584	-0.052	-0.052	0.192
LOWINC	0.096	0.818	-0.062	0.021	-0.087	0.108
NOINS	-0.053	-0.028	-0.076	0.045	-0.767	0.128
MDCARE	-0.065	-0.041	-0.019	0.060	0.761	0.169
MDCAID	0.012	0.799	-0.096	-0.044	0.050	-0.035
NUMBER	0.776	0.119	-0.197	-0.023	-0.139	0.003
MEDHRS	0.663	0.099	-0.104	-0.109	0.168	0.107
NONMHRS	-0.021	0.015	-0.021	-0.220	0.018	0.693
PROFHRS	-0.064	0.078	0.260	0.145	-0.001	0.590
OVER10	-0.018	0.124	0.522	0.488	0.072	-0.192
WHITE	0.125	-0.483	-0.051	0.541	-0.054	-0.035
MALE	0.422	-0.043	-0.094	0.249	0.094	0.341
EXPER	-0.211	-0.005	-0.071	0.780	0.008	0.015
STYLES	(i)	(ii)	(iii)		(iv)	(v)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.190	13.7	13.7	AIDPRMD	0.459
2	1.880	11.7	25.4	NETINC	0.605
3	1.453	9.1	34.5	FEEOFF	0.590
4	1.229	7.7	42.2	HIINC	0.440
5	1.195	7.5	49.7	LOWINC	0.702
6	1.080	6.8	56.4	NOINS	0.616
7	0.960	6.0	62.4	MDCARE	0.617
8	0.902	5.6	68.1	MDCAID	0.653
9	0.825	5.2	73.2	NUMBER	0.675
10	0.781	4.9	78.1	MEDHRS	0.511
11	0.725	4.5	82.6	NONMHRS	0.530
12	0.694	4.3	87.0	PROFHRS	0.446
13	0.625	3.9	90.9	OVER10	0.567
14	0.550	3.4	94.3	WHITE	0.549
15	0.483	3.0	97.3	MALE	0.376
16	0.429	2.7	100.0	EXPER	0.689

Table 3.12: Percentage of Variance Explained by Each Factor (All Variables)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.962	11.0	11.0	AIDPRMD	0.584
2	2.551	9.4	20.4	NETINC	0.626
3	2.096	7.8	28.2	FEEOFF	0.580
4	1.840	6.8	35.0	HIINC	0.402
5	1.736	6.4	41.4	LOWINC	0.720
6	1.441	5.3	46.8	NOINS	0.450
7	1.330	4.9	51.7	MDCARE	0.714
8	1.171	4.3	56.0	MDCAID	0.657
9	1.124	4.2	60.2	NUMBER	0.695
10	1.020	3.8	64.0	MEDHRS	0.519
11	0.953	3.5	67.5	NONMHRS	0.451
12	0.923	3.4	70.9	PROFHRS	0.444
13	0.846	3.1	74.0	FAMGP	0.786
14	0.820	3.0	77.1	SURGERY	0.810
15	0.748	2.8	79.9	PEDTRCS	0.815
16	0.744	2.8	82.6	OBGYN	0.841
17	0.718	2.7	85.3	INTRNST	0.825
18	0.613	2.3	87.5	BCERT	0.638
19	0.571	2.1	89.7	SIZE	0.453
20	0.544	2.0	91.7	CNTYINC	0.742
21	0.484	1.8	93.5	PHYSSQM	0.800
22	0.464	1.7	95.2	PHYSPOP	0.779
23	0.392	1.5	96.6	AGED	0.757
24	0.366	1.4	98.0	OVER10	0.587
25	0.324	1.2	99.2	WHITE	0.474
26	0.221	0.8	100.0	MALE	0.533
27	0.000	0.0	100.0	EXPER	0.586

Table 3.13: Varimax Rotated Factor Matrix (All Variables)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
AIDPRMD	-0.088	0.113	0.035	0.630	-0.021	-0.070	0.387	0.074	0.055	-0.018
NETINC	0.033	0.291	0.024	0.649	-0.115	0.202	-0.149	0.206	0.006	-0.020
FEEOFF	0.182	0.268	0.216	0.097	-0.005	0.528	0.039	0.186	-0.183	0.267
HIINC	0.070	0.204	0.086	-0.093	-0.181	0.288	0.202	0.066	-0.072	0.417
LOWINC	0.001	-0.094	-0.046	0.070	0.815	0.034	0.005	0.018	0.153	0.125
NOINS	0.178	-0.092	-0.436	-0.078	-0.042	0.020	0.273	-0.150	0.338	0.028
MDCARE	0.031	-0.084	0.814	-0.051	-0.022	-0.193	-0.021	-0.018	0.048	0.019
MDCAID	-0.011	-0.052	-0.030	0.028	0.793	-0.098	-0.095	0.064	-0.026	-0.028
NUMBER	-0.125	-0.128	-0.208	0.758	0.090	-0.120	0.103	-0.080	0.065	0.027
MEDHRS	-0.071	-0.060	0.082	0.672	0.077	0.039	-0.130	-0.165	-0.006	0.028
NONMHRS	0.327	-0.156	0.105	0.082	-0.033	0.018	-0.183	-0.474	-0.029	0.208
PROFHRS	0.194	-0.009	-0.010	0.060	0.082	-0.050	0.015	0.023	-0.155	0.607
FAMGP	-0.063	-0.809	0.036	0.151	0.000	-0.203	0.154	0.093	0.051	-0.164
SURGERY	-0.010	0.195	0.098	-0.041	0.060	-0.078	-0.866	-0.008	0.034	-0.001
PEDTRCS	0.098	0.335	-0.721	-0.029	0.003	-0.368	0.137	-0.017	-0.128	0.029
OBGYN	-0.062	0.084	-0.206	-0.022	0.004	0.869	0.034	-0.047	0.068	-0.156
INTRNST	0.051	0.399	0.615	-0.093	-0.005	-0.131	0.412	-0.044	-0.040	0.286
BCERT	0.009	0.732	-0.141	0.058	-0.091	0.076	-0.239	-0.027	-0.013	0.088
SIZE	-0.015	0.560	0.034	0.175	-0.031	-0.029	0.225	0.075	0.059	-0.213
CNTYINC	0.394	-0.011	-0.062	-0.199	-0.084	-0.013	0.024	-0.015	-0.722	0.114
PHYSSQM	0.882	-0.043	-0.012	-0.075	0.015	-0.013	0.019	-0.021	-0.100	0.061
PHYSPOP	0.855	0.137	-0.066	-0.110	-0.001	0.045	0.024	0.083	-0.035	0.042
AGED	0.589	-0.008	0.028	-0.084	0.001	-0.033	-0.044	0.073	0.628	-0.012
OVER10	0.142	0.002	0.103	0.065	0.005	0.078	-0.034	0.731	-0.097	0.026
WHITE	-0.031	-0.065	-0.075	0.047	-0.558	-0.073	-0.032	0.330	0.116	0.142
MALE	-0.214	0.001	0.053	0.252	-0.048	-0.099	-0.123	-0.048	0.272	0.564
EXPER	0.050	-0.320	-0.041	-0.269	-0.146	-0.056	-0.048	0.546	0.242	0.153
STYLES		(iii)	(iv)	(i)	(ii)	(iii)		(v)		(v)

mathematical ability. For example, the use of aides, net income, number of patients and number of medical hours are indicators of style (i). If a physician adopts style (i), he will, in general, have high values of these observed variables.

While we refer to a physician as "adopting" a style, these styles are continuous, not discrete. Strictly speaking, a physician does not have "to choose" one style over another. Rather, our research has identified certain "types" of physicians and the latent variable "style" should be thought of as a continuous variable, more similar to a probability of being a certain "type" than a discrete choice.

Whether a physician has a practice that is more closely related to one style or another depends on certain predetermined variables. Initially we focus on four exogenous variables: sex, race, experience and over ten thousand dollars outside income. One can expect these variables to have significant effects on style. For example, minority physicians may be more likely than white physicians to treat low income and Medicaid patients, which will be evidenced by a significant correlation between the race variable and style (iii). Since the effects of these exogenous variables on styles are unknown we postulate a model in which all the exogeneous variables affect all the styles. This model is represented in figure 3.2 and the results are reported in Table 3.14. Subsequently, we include additionally specially, board contribution and regional characteristics as predetermined variables and present these results in Table 3.15.

e.ii) Formal Description and Notation

The most succinct way to write the model follows; the notation is identical to Jöreskog (1973). We let $\eta' = (\eta_1, \ldots, \eta_m)$ denote a random

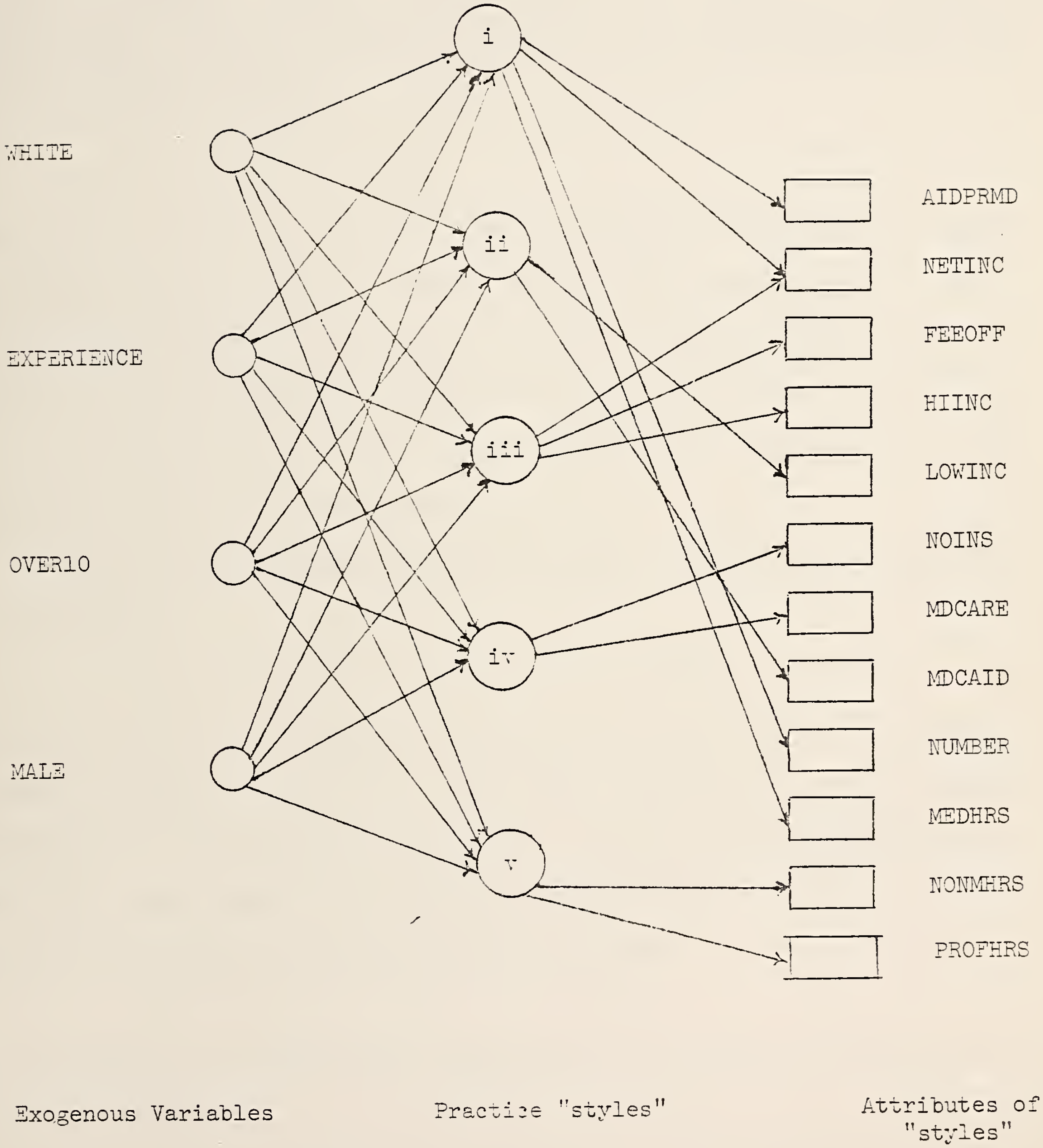

Figure 3.2: Preliminary Causal Model of Physicians' Practice Attributes

vector of m latent, true endogenous variables; these variables are our practice styles. We let $\xi' = (\xi_1, \ldots, \xi_n)$ denote a vector of n latent, true exogenous variables; these variables are our exogenous physician characteristics. These variables are related by an interdependent system of linear structural relations:

$$B\eta = \Gamma\xi + \zeta \qquad (3.9)$$

where B (m x m) and Γ (n x n) are parameter matrices and we employ the usual standardization of setting the diagonal elements of B equal to unity. ζ(m x 1) is a random vector of disturbances (errors in equations) with $E(\zeta) = 0$. Without loss of generality we suppose that η_i $(i = 1, \ldots, m)$ and ξ_j $(j = 1, \ldots, n)$ are standardized to have zero mean. Further, we assume that B is non-singular and ξ is uncorrelated with ζ.

The vector η is unobserved, instead we observe a vector of indicators y(p x 1) such that:

$$y = \Lambda_y\eta + \varepsilon \qquad (3.10)$$

where Λ_y (p x m) is a matrix of loadings and ε(p x 1) is a vector of measurement errors. $E(\varepsilon) = 0$ and each element of ε is distributed independently of each element of η, ξ and ζ. Without loss of generality, each element of y has zero mean. In our application, the y variables are the observed characteristics of the physician's practice.

The vector ξ is unobserved; instead we observe a vector of indicators x (q x 1) such that:

$$x = \Lambda_x\xi + \delta \qquad (3.11)$$

where Λ_x (q x n) is a matrix of loadings and δ (q x 1) is a vector of measurement errors. $E(\delta) = 0$ and each element of δ is distributed independently of each element of η, ξ, ζ and ε. Again, it is assumed that each element of x has zero mean.

Finally, Φ $(n \times n)$ and Ψ $(m \times m)$ denote the variance-covariance matrices of ξ and ζ, respectively. θ^2_ε $(p \times p)$ and θ^2_δ $(q \times q)$ are diagonal matrices of error variances of y and x, respectively. The elements of Ψ provide a measure of goodness of fit. Since ζ_i denoted the error associated with equations i $(i = 1,\dots,m)$, the goodness of fit of this equation is given by

$$R^2_i = 1 - \mathrm{var}(\zeta_i)$$

$$R^2_i = 1 - \Psi_{ii} \qquad (3.12)$$

In the maximum likelihood models we assume that the vector of manifest (observable) variables $z = (y',x')'$ is distributed according to the multivariate normal.

Equation (3.10) is the matrix representation of the factor analysis model. In particular, it formalizes the factor analyses we conducted in previous sections in order to identify physician styles.

In our application we made two simplifying assumptions. First, we assume that $B = I$, the identity matrix. This assumption means we suppose that practice styles are not causally related to one another. Second, we assume that each latent exogenous variable is measured without error, which means $x = \xi$. Thus, the model we will estimate can be written:

$$\eta = \Gamma x + \zeta \qquad (3.13)$$

$$y = \Lambda_y \eta + \varepsilon \qquad (3.14)$$

The model requires us to postulate exclusion restrictions for Γ and Λ_y, that is, we must specify which parameters of these matrices equal zero. We shall begin with the most simple structure and will increase the number of variables and the complexity of the model at each stage. Initially, we take the structure of Λ_y from table 3.6. When a variable in this table has a loading of less than 0.4 (in absolute value) on a factor we set the corresponding element of Λ_y equal to zero. When a variable has a loading greater than 0.4 in absolute value we allow the corresponding parameter of Λ_y to be free and will estimate it. All parameters in Γ are free.

The model was estimated in two ways, with the off-diagonal elements of Ψ, the variance-covariance matrix of errors across equations, set equal to zero and with them free. We report the results obtained with off-diagonal elements set equal to zero because when these parameters are free the results do not change substantially and in more complicated models, identification problems emerge. The results are standardized such that the variance of each element of η equals unity. The variance of x and y also equals unity because the input consists of the correlation matrix.

e. iii) Results

Consider first Λ_y . For styles (i) through (v) the results are very consistent with the a priori model -- all loadings have the right sign and are larger than 0.4. We now consider gamma for styles (i) through (v). Physician's race (WHITE) has a large negative coefficient in the equation corresponding to style (ii). This result is consistent with previous findings and shows that minority physicians are most likely to treat low income and Medicaid patients than are white physicians, more specifically, the probability of treating low income and Medicaid patients is higher for

minority physicians than for white physicians.[14] Also consistent with previous findings, over $10,000 outside income has a positive effect on style (iii) -- physicians with outside income charge high fees and see high income patients. Sex (MALE) has its highest loading on style (i). The negative coefficient of experience on style (i) is a new finding; it shows that older, possibly semi-retired physicians work fewer hours and see fewer patients than do younger physicians.

In general, the exogenous variables in Table 3.14 do not seem to be good predictors of the style of practice. This can be seen in the consistently low coefficients of the matrix and the R^2's associated with each style's equation. When the variance of η is standardized to unity, the R^2's for each equation may be computed by subtracting the appropriate diagonal element of PSI from 1.0. Thus, the R^2's for the style equations in Table 4.C1 vary from .184 for style (ii) to .017 for style (v). In addition, the estimated measurement error variances of the manifest indicators of practice style (THETA EPS) are high (.693 to .939).

e. iv) Preliminary Analysis of a more Complete Causal Model

In Table 3.15 the model is estimated a second time with the addition of specialty, board certification, size and indicators of geographic location as exogenous determinants of practice style. Although specialty is undeniably a choice made by the physician, specialty clearly preceeds the choice of practice style in the physician's career. Choice of specialty is made in the course of the physician's medical training and once set, is rarely altered.

---

[14] It does not mean that a low income or Medicaid patient is more likely to be treated by a minority physician than by a white physician.

The physicians in our data are not in a position to adjust specialty with the same ease they adjust the number of patients seen per week or hours worked per week. If one expects specialty to be a good predictor of style, one must believe that the choice of specialty does not uniquely determine the style of practice. Then one can argue that speciaty is, in part, a manifest indicator of the physician's preferences for practice style and these preferences are, of course, considered exogenous determinants of the practice style. Low coefficients on specialty dummy variables in the style equations would then be interpreted as a lack of consistency in specialists' preferences for practice styles.

Table 3.15 shows the result of adding specialty, board certification, size and regional variables to the style equations. The Λ_y matrix is similar to Table 3.14 as are the columns of the gamma matrix corresponding to OVER10, WHITE, MALE and EXPER (though the coefficients on experience in the third equation, and OVER10 and MALE in the fourth equation are somewhat reduced).

Since the specialties are dummy variables one category has to be dropped. In this case we excluded surgeons for each equation. General practitioners/family practice specialists (FAMGP) load highly on style (i). Pediatricians (PEDTRCS) have a large negative loading on style (iv) - they do not treat Medicare patients and tend to see fewer patients with insurance coverage than do other physicians. Obstetricians and gynecologists (OBGYN) most likely tend to practice in style (iii) and least likely to practice in style (iv). Specialists in internal medicine (INTRNST) load positively on style (iv) representing the Medicare, insured patient style. Internists tend to treat more complex cases which characterize older patients. The positive

Table 3.14: Maximum Likelihood Estimates of the Preliminary Causal Model

LAMBDA Y

	Style					
	(i)	(ii)	(iii)	(iv)	(v)	θ_{ε_s}
AIDPRMD	.504					.868
NETINC	.468		.456			.773
FEEOFF			.570			.817
HIINC			.358			.939
LOWINC		.618				.783
NOINS				-.473		.883
MDCARE				.515		.855
MDCAID		.493				.874
NUMBER	.731					.693
MEDHRS	.575					.821
NONMHRS					.402	.917
PROFHRS					.370	.934

GAMMA

Style	OVER 10	WHITE	MALE	EXPER	PSI
(i)	.007	.031	.225	-.254	.887
(ii)	.002	-.422	.118	-.009	.816
(iii)	.377	.067	.045	-.142	.855
(iv)	.182	.031	.126	-.073	.952
(v)	.009	-.124	.026	-.028	.983

coefficient of INTRNST and the negative coefficient of FAMGP in the third equation reflects, to some extent, the substitution of internists for GP/family practice specialists by wealthy patients.

Board certified (BCERT) physicians are most strongly associated with style (iii) - high fee, high income patients and negatively associated with style (ii) - Medicaid, low income patients. Size is not strongly associated with any style although it is positive in style (i) and negative in style (v). Among the geographic variables style (v) and, to a lesser extent, style (iii) appear to be related to physician-rich, high income areas, while style (i) is negatively related to physician-rich, high income areas. Geographic areas with a large percentage of the population over age 65 (AGED) do not seem to be strongly associated with any style.

The R^2's for the expanded model show significant improvement over those of Table 3.14. As one might predict from its relatively strong relationship to specialty, the equation for style (iv) has the largest R^2 of .643, while the lowest R^2 is that of equation (v), .232. Estimates of theta eps, the measurement error, are notably improved over Table 3.14 for NETINC, MDCARE AND NUMBER and only slightly higher for MDCAID, NOINS, MEDHRS and HIINC.

Table 3.15: Maximum Likelihood Estimates of the Preliminary Causal Model Including Specialty and Geographic Location

LAMBDA Y

	Style					
	(i)	(ii)	(iii)	(iv)	(v)	θ_{ε_s}
AIDPRMD	.513					.858
NETINC	.504		.479			.767
FEEOFF			.616			.787
HIINC			.378			.930
LOWINC		.624				.774
NOINS				-.319		.951
MDCARE				.815		.562
MDCAID		.481				.880
NUMBER	.752					.652
MEDHRS	.541					.841
NONMHRS					.425	.908
PROFHRS					.397	.924

GAMMA

Style	FAMGP	PEDTRCS	OBGYN	INTRNST	BCERT	SIZE	CNTYINC
(i)	.316	.239	.131	.064	.066	.082	-.241
(ii)	.000	.060	-.059	-.161	-.138	.013	-.111
(iii)	-.307	-.206	.152	.172	.163	.017	.073
(iv)	.101	-.523	-.341	.424	.057	-.071	.033
(v)	-.050	-.126	-.180	.074	.014	-.108	.175

Style	PHYSSQM	AGED	OVER10	WHITE	MALE	EXPER	PSI
(i)	-.055	-.072	-.024	.055	.212	-.231	.739
(ii)	.117	-.022	.006	-.415	.135	.038	.753
(iii)	.141	-.108	.308	.053	.049	-.007	.516
(iv)	-.041	.038	.081	.036	-.033	-.047	.357
(v)	.254	.096	-.011	-.112	.063	-.051	.768

4. CONFIRMATORY ANALYSIS USING 1975 AND 1976 DATA

a) Analysis of Practice Attribute Variables

The results using the 1975 data are exploratory. We wish to test our methods and our results by estimating the same models using the 1976 data (n = 1050). Unfortunately, not all variables are available in both data sets. The percentage of high income (HIINC) and low income (LOWINC) patients seen by the physician are missing from the 1976 data. However, the percentage of patients who are black, BLKPAT, is included in both data sets and this is used in the comparative analyses. Neither the physician's race (WHITE) nor the question concerning over $10,000 income from sources outside the practice (OVER10), appear in the 1976 data and, unfortunately, there are no suitable substitutes.

Table 4.1 shows the means and standard deviations of the 1976 variables. The definitions of the variables are the same for both years and may be found in Table 3.1.[15]

First, we perform factor analyses on the practice attribute variables. In contrast to the previous analyses for the 1975 data HIINC and LOWINC are omitted, but BLKPAT is included so that the same variables are used in both analyses. The varimax rotated factor matrices for the 1975 and 1976 data appear in Tables 4.2 and 4.3, respectively. Comparison of Table 3.6 with Table 4.2 reveals a close correspondence of the original 1975 styles with the 1975 styles to be used for validation purposes. Furthermore, it is evident from Tables 4.2 and 4.3 that the same factors, with minor differences, are

---

[15] Note that FEEOFF and NETINC were not standardized by a cost of living index in the 1976 data because no index was provided.

identified in both the 1975 and 1976 data. Styles (i), (ii) and (iv) are reproduced exactly, using .4 as the cutoff level for "significant" contribution to a factor. Style (iii) exists, but is not so pronounced because the variable HIINC is excluded from these analyses. While net income (NETINC) loads highest on style (iii) in the 1975 data it loads highest on style (i) in the 1976 data. This result is not disturbing because in the original analysis of the 1975 data (Table 3.6) this variable loads on both style (i) and style (iii). The other divergence of 1976 styles from 1975 styles appears in style (v) which includes the number of hours per week spent seeing patients (MEDHRS) in 1976, but not in 1975. The style (v) association of administrative hours (NONMHRS) and hours in other professional activities (PROFHRS) is preserved in the 1976 data.

Next we add to the factor analysis the early career choice variables including specialty, board certification, size of the practice and geographic variables. The rotated factor matrices for the 1975 and 1976 data appear in Tables 4.5 and 4.7, respectively. A comparison shows little difference among the identified styles. Styles (i) and (ii) are clearly identified in both tables. So is style (iv) but in the 1976 results it appears in two factors T4.7-F5 and T4.7-F6. Style (iii), appears in two factors in both Tables; in all factors net income and office fees have moderate loadings. In T4.5-F1 and T4.7-F3 family practice - general practitioners has a negative loading and board certification and size have positive loadings, while in T4.5-F5 and T4.7-F4 pediatricians is negative and obstetricians-gynecologist is positive. Style (v) is moderately associated with medical hours in 1976, but not in 1975. Of particular interest is T4.7-F1 which identifies a group of physicians living in areas with high county incomes, many physicians per square mile and per person, and charging high fees. Exploratory analysis

using the 1975 data did not identify this style; these geographic variables were more strongly associated with style (v) (see T4.5-F6) than with high fees.

b) Addition of the Exogenous Variables

In the original 1975 data there are four exogenous variables: OVER10, WHITE, MALE and EXPER, only MALE and EXPER remain in the comparative analyses. Addition of the exogenous variables sex (MALE) and experience (EXPER) to the eleven practice attributes variables leaves the loading of the practice attribute variables relatively unchanged; compare Table 4.2 with 4.8, and Table 4.3 with Table 4.9.[16] Comparison of the 1975 and 1976 results shows that the loadings of the practice attribute variables are very similar. Some differences exist among the exogenous variables. For example in the 1975 data male has a high loading on style (i) while in the 1976 data experience has a relatively large, negative coefficient on style (i). Also, in the 1976 data experience has a positive loading on the factor corresponding to the opposite of style (iii). When, however, the early career choice variables are added, as in Tables, 5.8 and 5.9, these apparent differences appear slight. For example, for both years male has a positive loading on style (i) and experience has a negative loading on style (i), but no coefficient exceeds 0.4.

In summary, the 1976 data seem to validate the findings based on the 1975 data. In fact, the original 1975 results are more similar to the new 1976 results than they are to the 1975 results without OVER10 and WHITE. The results are very robust. Three of five styles are reproduced exactly (i, ii, and iv) and the other two are clearly identifiable in both data sets.

---

[16] In Table 5.7 the signs of style (iii) are reversed.

are assumed to be captured by the previous choice and exogenous variables. However, an alternative approach would be to assume a common structure of constraints and preferences among physicians (or a subset of physicians) and model the determination of style as a series of "blocks" of decisions, i.e., specialty, followed by geographic location, followed by size, followed by the practice style attributes in individual equations. The model might be block recursive, that is, each block of decisions might affect only subsequent blocks of decisions. Alternatively one block might feed back to previous blocks. The major differences between these block models and the causal models in this report is that the final block would contain individual equations for each of the practice attributes rather than a smaller number of equations, one for each style of practice. The premise of the block model is that styles are not directly determined by previous choices and exogenous factors but instead are determined by simultaneously adjusting the values of all variables which describe the style. This adjustment process, however, may be influenced by previous choices and exogenous variables. To date, we have specified such models and found that all equations can be identified if the first block of decisions, i.e., specialty, is taken as exogenous. We are presently continuing work on these block decision models.

REFERENCES

Aiken, Linda H., Charles E. Lewis, John Craig, Robert C. Mendenhall, Robert J. Blendon and David E. Rogers, "The Contribution of Specialists to the Delivery of Primary Care: A New Perspective," The New England Journal of Medicine, 300, Number 24, 1979, 1363-1370.

Amemiya, Takeshi, "Multiple Regression and Simultaneous Equation Models When the Dependent Variables are Truncated Normal," Econometrica 42, 1974, 999-1012.

Amemiya, Takeshi, "Qualitative Response Models," Annals of Economic and Social Measurement 4, 1975, 363-72.

American Medical Association, Reference Data on Profile of Medical Practice. (Henderson, Sharon R., ed.), 1977 edition. Center for Health Services Research and Development, A.M.A. Chicago, 1977.

American Medical Association, Profile of Medical Practice, 1975/6. (Cantwell, James R., ed.), Chicago: 1976.

American Medical Association, Measuring Physician Manpower: Contributions to a Comprehensive Health Manpower Strategy, Center for Health Services Research and Development, (1973).

Bailey, Richard M. "Economies of Scale in Medical Practice," in H. Klarman (Ed.) Empirical Studies in Health. Baltimore: Johns Hopkins Press, 1970, 255-277.

Bell, David E., Keeney, Ralph L., and Howard Raiffa (Eds.), Conflicting Objectives in Decisions. New York: John Wiley & Sons, 1977.

Benham, L., Maurizi, A. and M.W. Reder. "Migration, Location and Remuneration of Medical Personnel: Physicians and Dentists," Review of Economics and Statistics 50, 1968, 332-47.

Blackstone, E.A., "Misallocation of Medical Resources: The Problem of Excessive Surgery," Public Policy 22, 1974, 329-352.

Bloom, Bernard S. and Samuel P. Martin, "Pricing of Physician Services," Leonard Davis Institute of Health Economics, University of Pennsylvania (undated).

Blumberg, M. "Office Based Physicians: New Earnings from Office and Hospital Services," (unpublished).

Boardman, Anthony E., Hui, Baldwin S. and Herman Wold, "The Partial Least Squares - Fix Point Method of Estimating Interdependent Systems with Latent Variables," Communications in Statistics A 10, 1981, .

Brown, Douglas M., Feldstein, Martin S. and Harvey E. Kaplan, "The Rising Prices of Physicians' Services: A Clarification," Review of Economics and Statistics 56, 1974, 396-98.

Brown, Douglas M. and Harvey E. Lapan, "The Supply of Physicians' Services," Economic Inquiry 17, 1979, 269-79.

Burney, Schrieber, Blaxall and Gabel, "Geographic Variation in Physicians' Fees," Journal of The American Medical Association 240, 1978.

Carroll, Marjorie Smith and Ross H. Arnett III, "Private Health Insurance Plans in 1977: Coverage, Enrollment and Financial Experience," Health Care Financing review, Fall 1979, 3-22

Charles, Stinson and Rogerson, "Analysis of a Group Practice: Preliminary Findings from a Problem Oriented Information System," Working Paper number 9. San Francisco Veterans Administration Hospital, 1977.

Cochrane, James L. and Milan Zeleny (eds.), Multiple Criteria Decision Making. Columbia, S.C.: University of South Carolina Press, 1973.

Davis, Karen and Cathy Schoen, Health and the War on Poverty: A Ten-Year Appraisal. Washington, D.C. The Brookings Institution, 1978.

Eisenberg, John M., "An Educational Program to Modify Laboratory Use by House Staff," Journal of Medical Education 52, 1977, 578-581.

Ellickson, Bryan, "Hedonic Theory and Housing Markets," Discussion Paper #124, July 1978.

Evans, Robert G., "Supplier Induced Demand," in M. Perlman (Ed.) The Economics of Health and Medical Care. London: Macmillan, 1974, 162-173.

Evans, Robert G., Price Formation in the Market for Physician Services in Canada. Prices and Incomes Commission, Information Canada, Ottawa, Chapter 2, 1972.

Evans, R.G., "Modelling the Economic Objectives of the Physician," in R.D. Fraser (Ed.), Health Economics Symposium: Proceedings of the First Canadian Conference. Industrial Relations Center, Queen's University at Kingston, Canada, 1976.

Evans, R.G. and M.F. Williamson, Extending Canadian Health Insurance: Options for Pharmacare and Denticare. Ontario Economic Council, University of Toronto Press, 1978, Chapter 6.

Feldstein, Martin S., "Econometric Studies of Health Economics," Discussion Paper #291, Harvard Institute of Economic Research, Cambridge, Massachusetts, April 1973.

Feldstein, Martin S., "The Rising Price of Physicians' Services," Review of Economics and Statistics 52, 1970, 121-133.

Friedman, Milton, "The Methodology of Positive Economics," in M. Friedman (ed.), Essays in Positive Economics. Chicago: Chicago Press, 1935, 455-57.

Frech, H.E. III and Paul B. Ginsberg. "Physician Pricing: Monopolistic or Competitive: Comment," Southern Economic Journal 38, 1972, 573-77.

Fuchs, Victor R., Who Shall Live? Health, Economics, and Social Choice. Basic Books: New York, 1974.

Fuchs, V. and Kramer, M., "Expenditures for physicians' services in the United States, 1948-1968," National Bureau of Economic Research, 1971. Unpublished paper, cited in Feldstein (1973).

Funkenstein, Daniel H., Medical Students, Medical Schools, and Society During Five Eras: Factors Affecting the Career Choices of Physicians, 1958-1976. Cambridge, Mass.: Ballinger, 1978.

Garg, Mulligan and Gilbe, "Physician Specialty: Quality and Cost of Inpatient Care," American Public Health Association, Washington, D.C., November 1977.

Hausman, Jerry A. and David A. Wise, "A Conditional Probit Model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preferences," Econometrica 46, 1978, 403-26.

Hechman, James J., "Dummy Endogenous Variables in a Simultaneous Equation System," Econometrica 46, 1978, 931-59.

Heckman, James J., "Simultaneous Equations Models with Continuous and Discrete Endogenous Variables and Structural Shifts," in Stephen M. Goldfeld and Richard E. Quandt (eds.), Studies in Nonlinear Estimation. Cambridge, Mass.: Ballinger, 1977.

Henderson, James M. and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach. New York: McGraw-Hill, 1971.

Henderson, S.R., (ed.) Profile of Medical Practice, 1977. Center for Health Services Research and Development, American Medical Association, Chicago, 1977.

Hildebrand, David K., James D. Laing and Howard Rosenthal, Prediction Analysis of Cross Classifications. New York: Wiley, 1976.

Holahan, John F. and William Scanlan, "Price Controls, Physician Fees and Physician Incomes from Medicare and Medicaid," The Urban Institute, Washington, D.C., 1978.

Hughes, E.F.X., V. Fuchs and E.M. Lewit, "Surgical Work Loads in a Community Practice," Surgery 71, 1972, 315-27.

Johnston, J., Econometric Methods (2nd edition). New York: McGraw-Hill, 1972.

Jöreskog, Karl G., "A General Method for Estimating a Linear Structural Equation System," in Arthur S. Goldberger and Otis Dudley Duncan (eds.), Structural Equation Models in the Social Sciences. New York: Seminar Press, 1973, 85-112.

Jöreskog, K.G. and A.S. Goldberger, "Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable," Journal of the American Statistical Association, 10; 631-639.

Keeney, Ralph L. and Howard Raiffa, Decisions With Multiple Objectives: Preferences and Value Tradeoffs. New York: John Wiley & Sons, 1976.

Kehrer, B. and J.C. Knowles, "Economics of Scale and Pricing of Physicians Services," in D.E. Yett (Project Director), An Original Comparative Economic Analysis of Group Practice and Solo Fee-For-Service Practice - Final Report Analyses from the Seventh Periodic Survey of Physicians, PB-241546, Springfile, Va., 1974, 422-521.

Kessel, Reuben A., "Price Discrimination in Medicine," Journal of Law and Economics, 1, October, 1958.

Kmenta, Jan, Elements of Econometrics. New York: Macmillan, 1971.

Kushman, John E., "Participation of Private Practice Dentists in Medicaid," Inquiry 15, 1978, 255-33.

Lewis, C.E. "The State of the Art in Quality Assessment," Medical Care 12, 1974, 799-806.

Maddala, G.S. and F.D. Nelson, "Analysis of Qualitative Variables," Working Paper #70, NBER, 1974.

Masson, Robert T., and S. Wu, "Price Discrimination for Physicians' Services," Journal of Human Resources, 9, 1974, 63-79.

McFadden, Daniel, "Conditional Logit Analysis of Qualitative Choice Behaviour," in Paul Zarembka (ed.), Frontiers in Econometrics. New York: Academic Press, 1974.

McFadden, Daniel, "Quantal Choice Analysis: A Survey," Annals of Economic and Social Measurement 5, 1976, 363-90.

Morrison, Donald F., Multivariate Statistical Methods. New York, McGraw-Hill 1967.

Nerlove, Marc and James S. Press, "Univariate and Multivariate Log-Linear and Logistic Models," Santa Monica, CA: The Rand Corporation, 1973.

Newhouse, Joseph P. "A Model of Physician Pricing," Southern Economic Journal 37, October, 1970, 174-83.

Newhouse, Joseph P., The Economics of Medical Care: A Policy Perspective. Reading, Mass.: Addison-Wesley, 1978.

Newhouse, Joseph P. and Frank A. Sloan, "Physician Pricing: Monopolistic or Competitive: Reply," Southern Economic Journal 38, 1972, 577-80.

Nickerson, Rita S., Colton and Oster L. Peterson. "Doctors Who Perform Operations: A Study on Inhospital Surgery in Four Diverse Geographic Areas," New England Journal of Medicine 295, 1976, 921-26, 982-89.

Olsen, Randall J., "Comment on 'The Effect of Unions on Earnings and Earnings on Unions: A Mixed Logit Approach'," International Economic Review 19, 1978, 259-61.

Owens, A. "The New Surge in Physicians' Earnings and Expenses," *Medical Economics* 46, 1969, 83-88.

Owens, Arthur, "Who are the High Fee Doctors," *Medical Economics*, June 9, 1980, 196-203.

Pauly, Mark V. and Mark A. Satterthwaite, "The Pricing of Primary Care Physicians' Services: A Test of the Role of Consumer Information," Discussion Paper #26, Center for Health Services and Policy Research, Northwestern University, 1979.

Pauly, Mark V. and Michael Redisch, "The Not-For-Profit Hospital as a Physicians' Cooperative," *American Economic Review* 63, 1973, 87-99.

Pauly, M. and Satterthwaite, M., "The Effect of Provider Supply on Price," working paper #18, Northwestern University. June, 1978, revised August, 1978.

Phelps, Charles E., "Demand for Reimbursement Insurance", in Rosett, Richard N. (ed.) *The Role of Health Insurance in the Health Services Sector* NBER: New York, 1976, 115-162.

Pineault, R., "The Effect of Medical Training Factors on Physician Utilization Behavior," *Medical Care* 15, 1977, 51-67.

Reinhardt, U E., "An Economic Analysis of Physicians' Practices," unpublished doctoral dissertation, Yale University, 1970.

Reinhardt, U E., "A Production Function for Physician Services," *Review of Economics and Statistics* 54, 1972, 55-66.

Reinhardt, Uwe E., *Physician Productivity and the Demand for Health Manpower: An Economic Analysis*. Cambridge, Massachusetts: Ballinger, 1975.

Rimlinger, Gaston V. and Henry B. Steele, "An Economic Interpretation of the Spatial Distribution of Physicians in the U.S.," *Southern Economic Journal* 30 (1), July, 1963, 1-12.

Rimlinger, G. and Steele, H. "Income Opportunities and Physician Location Trends in the United States," *Western Economic Journal*, 1965, 182-194.

Rosen, Sherwin, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* 82, 1974, 34-55.

Rosenthal, Robert W., "A Model in Which an Increase in the Number of Sellers Leads to a Higher Price," *Econometrica*, 48, 1980, 1575-79.

Ruffin and Leigh. "Charity, Competition, and the Pricing of Doctors' Services," memo, Washington State University, 1969.

Satterthwaite, Mark A., "Consumer Information, Equilibrium Industry Price, and the Number of Sellers", *Bell Journal of Economics*, 10, 1979, 483-502.

Schmidt, Peter, "Estimation of a Simultaneous Equations Model with Jointly Dependent Continuous and Qualitative Variables: The Union - Earnings Question Revisited," *International Economic Review* 19, 1978, 453-65.

Schmidt, Peter and Robert P. Strauss, "Estimation of Models with Jointly Dependent Qualitative Variables: A Simultaneous Logit Approach," Econometrica 44, 1975, 745-55.

Schmidt, Peter and Robert P. Strauss, "The Effect of Unions on Earnings and Earnings on Unions: A Mixed Logit Approach," International Economic Review 17, 1976, 204-12.

Schroeder, Stephen A., "Variations in Physician Practice Patterns: A Review of Medical Cost Implications," Presented at a Working Conference on Physicians and Cost Control, Harvard School of Public Health, December, 1977.

Schroeder, S.A., K. Kenders, J.K. Cooper, and T.E. Piemme, "Use of Laboratory Tests and Pharmaceuticals - Variation Among Physicians and Effect of Cost Audit on Subsequent Use," Journal of the American Medical Association 225, 1973, 969-973.

Sickles, Robin C. and Peter Schmidt, "Simultaneous Equations Models with Truncated Dependent Variables: A Simultaneous Tobit Model," Journal of Economics and Business, 31, 1978, 11-21.

Sloan, F. A Microanalysis of Physicians' Hours of Work Decisions. Presented at the IEA Conference on Economics of Health and Medical Care. April 2-3, 1973, Tokyo.

Sloan, F., "Lifetime Earnings and Physicians' Choice of Specialty," Industrial Labor Relations Review 24, 1970, 47-56.

Sloan, Frank A., Tony Cromwell and Janet B. Mitchell, Private Physicians and Public Programs. Lexington, Mass.: Lexington Books, 1978.

Sloan, Frank A. and John H. Lorant, "The Allocation of Physicians' Services: Evidence on Length-of-Visit," Quarterly Review of Economics and Business 16, 1976, 86-103.

Steinwald, Bruce and Frank, A. Sloan, "Determinants of Physicians' Fees," Journal of Business 47, 4, 1974, 493-511.

Stone, Deborah A., "Physicians as Gatekeepers: The Organizational Uses of Medical Certification," Institute of Policy Sciences and Public Affairs, Duke University, 1977.

Theil, Henri, "A Multinomial Extension of the Linear Logit Model," International Economic Review 10, 1969, 251-59.

U.S. Department of Health, Education and WElfare, "National Ambulatory Medical Care Survey of Visits to General and Family Practitioners, January to December, 1975", from Vital and Health Statistics of the National Center for Health Statistics. Advance data No. 15, December 14, 1977.

U.S. Department of Health, Education and Welfare: The Supply of of Health Manpower: 1970 Profiles and Projections to 1990. Bureau of Health Resources Development. Publication No. (HRA) 75-38, Washington, D.C., Government Printing Office, December, 1974.

White, K.L., "Results of the National Ambulatory Medical Care Survey and Potential Uses of the Proposed Ambulatory Care Data Set," in: *Assessing Physician Performance in Ambulatory* Care, Proceeding of a conference sponsored by the American Society of Internal Medicine, June 18-19, 1976. San Francisco, pp. 171-193.

Williams, Sankey V., "Financial Incentives and Physician Behavior," (unpublished), University of Pennsylvania, September, 1977.

Wold, Herman, "Path Models with Latent Variables: The NIPALS Approach," *Quantitative Sociology* (H.M. Blalock, A. Aganbegian, F.M. Borodkin, Raymond Boudon, Vittoio Capecchi, eds.), New York: Seminar Press, 1975, 307-357.

Yett, D. and Sloan, F., "Analysis of migration patterns of recent medical school graduates." Paper presented at the Health Services Research Conference on Factors in Health Manpower Performance and the Delivery of Health Care, Chicago, December 9, 1971.

Table 4.1: Means and Standard Deviations - 1976 Variables

VARIABLE	MEAN	STANDARD DEV
AIDHRMD	83.50	61.54
AIDPRMD	2.62	1.73
NETINC	52820.00	27652.00
FEEOFF	13.26	4.90
BLKPAT	12.18	18.60
NOINS	12.22	14.42
MDCARE	21.94	23.21
MDCAID	14.09	15.93
NUMBER	170.09	95.26
MEDHRS	62.42	16.94
NONMHRS	4.69	4.90
PROFHRS	5.15	5.07
FAMGP	0.23	0.42
SURGERY	0.18	0.39
PEDTRCS	0.20	0.40
OBGYN	0.21	0.41
INTRNST	0.18	0.38
BCERT	0.48	0.50
SIZE	1.78	1.39
CNTYINC	4631.25	904.83
PHYSSQM	12.98	63.04
PHYSPOP	0.18	0.13
AGED	0.001	0.0003
MALE	0.96	0.20
EXPER	20.48	11.57

Table 4.2: Varimax Rotated Factor Matrix (1975 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
AIDPRMD	0.619	0.225	-0.140	-0.077	-0.113
NETINC	0.419	0.690	0.039	0.060	-0.137
FEEOFF	-0.189	0.773	0.097	-0.008	0.209
BLKPAT	-0.049	0.194	-0.125	0.753	-0.061
NOINS	-0.050	-0.107	-0.771	-0.124	0.058
MDCARE	-0.092	-0.007	0.756	-0.150	0.076
MDCAID	0.049	-0.154	0.095	0.793	0.042
NUMBER	0.812	-0.089	-0.107	0.088	-0.026
MEDHRS	0.733	-0.067	0.191	-0.017	0.114
NONMHRS	0.073	-0.133	0.061	-0.000	0.806
PROFHRS	-0.091	0.249	-0.044	-0.018	0.638
STYLES	(i)	(iii)	(iv)	(ii)	(v)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	1.870	17.0	17.0
2	1.420	12.9	29.9
3	1.269	11.5	41.4
4	1.153	10.5	51.9
5	1.081	9.8	61.8
6	0.889	8.1	69.8
7	0.765	7.0	76.8
8	0.749	6.8	83.6
9	0.722	6.6	90.2
10	0.580	5.3	95.4
11	0.501	4.6	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.472
NETINC	0.676
FEEOFF	0.687
BLKPAT	0.626
NOINS	0.627
MDCARE	0.609
MDCAID	0.666
NUMBER	0.687
MEDHRS	0.591
NONMHRS	0.676
PROFHRS	0.479

Table 4.3: Varimax Rotated Factor Matrix (1976 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
AIDPRMD	0.627	0.032	-0.067	-0.074	-0.001
NETINC	0.718	-0.066	-0.073	0.357	0.043
FEEOFF	-0.118	-0.001	0.080	0.869	0.033
BLKPAT	-0.009	0.829	0.038	0.115	0.153
NOINS	-0.142	-0.053	0.129	-0.329	-0.708
MDCARE	-0.099	-0.084	0.180	-0.188	0.791
MDCAID	0.014	0.836	0.011	-0.120	0.111
NUMBER	0.773	0.035	0.056	-0.361	0.023
MEDHRS	0.545	-0.056	0.597	-0.049	0.036
NONMHRS	-0.089	0.120	0.580	-0.068	0.081
PROFHRS	-0.034	-0.066	0.755	0.162	-0.050
STYLES	(i)	(ii)	(v)	(iii)	(iv)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	1.925	17.5	17.5
2	1.447	13.2	30.7
3	1.352	12.3	42.9
4	1.208	11.0	53.9
5	1.081	9.8	63.8
6	0.903	8.2	72.0
7	0.785	7.1	79.1
8	0.743	6.8	85.9
9	0.604	5.5	91.4
10	0.555	5.0	96.4
11	0.396	3.6	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.404
NETINC	0.655
FEEOFF	0.777
BLKPAT	0.725
NOINS	0.649
MDCARE	0.710
MDCAID	0.727
NUMBER	0.733
MEDHRS	0.660
NONMHRS	0.370
PROFHRS	0.605

c) Formulation of the Complete Causal Model

Based on a priori reasoning and our previous analyses we formulate a more complex causal model than the one presented in Chapter 3. Basically we propose a block recursive model which is represented in figure 4.1. Physicians first make early career decisions which concern primarily their type of specialty and geographic location. Subsequently, the physicians' styles of practice are adopted.

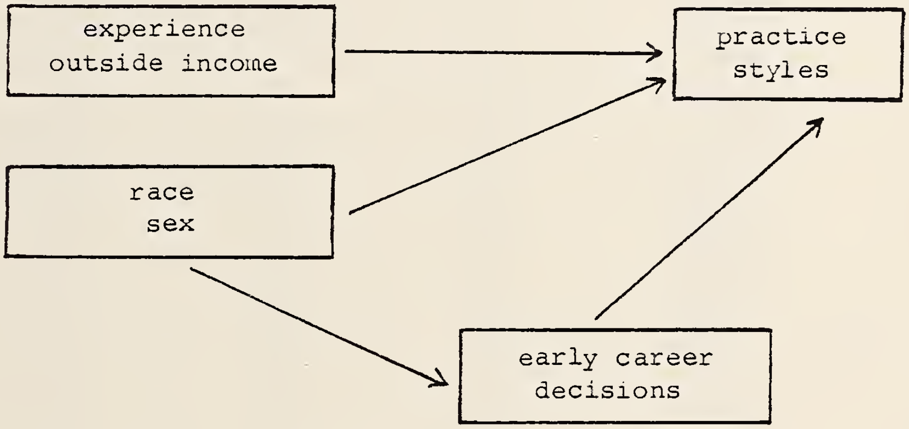

Figure 4.1: A Causal Model of Practice Style Adoption

Physicians choose a specialty while in training. Upon completion of training, their immediate concerns are geographic location and practice size. Usually, at this point physicians attempt to become board certified. Choice of specialty, geographic location, practice size, and success or failure in board certification generally precede the choice of practice style. These early career decisions are functions of a number of exogenous variables; among the set of potential exogenous variables we have data on physician's race and sex.

Table 4.4: Percentage of Variance Explained by Each Factor (Practice Attribute and Early Career Choice Variables, 1975 Data)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.819	12.8	12.8	AIDPRMD	0.581
2	2.391	10.9	23.7	NETINC	0.558
3	2.023	9.2	32.9	FEEOFF	0.547
4	1.706	7.8	40.6	BLKPAT	0.643
5	1.470	6.7	47.3	NOINS	0.389
6	1.309	6.0	53.3	MDCARE	0.701
7	1.213	5.5	58.8	MDCAID	0.598
8	1.072	4.9	63.6	NUMBER	0.704
9	0.949	4.3	68.0	MEDHRS	0.556
10	0.918	4.2	72.1	NONMHRS	0.354
11	0.864	3.9	76.1	PROFHRS	0.265
12	0.829	3.8	79.8	FAMGP	0.774
13	0.783	3.6	83.4	SURGERY	0.795
14	0.718	3.3	86.6	PEDTRCS	0.828
15	0.574	2.6	89.3	OBGYN	0.804
16	0.515	2.3	91.6	INTRNST	0.811
17	0.479	2.2	93.8	BCERT	0.646
18	0.423	1.9	95.7	SIZE	0.386
19	0.379	1.7	97.4	CNTYINC	0.749
20	0.343	1.6	99.0	PHYSSQM	0.784
21	0.224	1.0	100.0	PHYSPOP	0.764
22	0.000	0.0	100.0	AGED	0.765

Table 4.5: Varimax Rotated Factor Matrix (Practice Attributes and Early Career Choice Variables,1975 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
AIDPRMD	0.103	0.057	0.634	-0.012	-0.048	-0.104	0.386	-0.057
NETINC	0.323	0.043	0.600	0.049	0.285	-0.051	-0.073	0.017
FEEOFF	0.280	0.246	0.075	0.032	0.557	0.287	0.060	-0.071
BLKPAT	0.161	-0.004	-0.013	0.034	0.183	0.005	0.020	0.763
NOINS	-0.082	-0.431	-0.045	0.357	-0.049	-0.102	0.208	-0.106
MDCARE	-0.110	0.807	-0.035	0.047	-0.172	0.015	-0.052	-0.034
MDCAID	-0.145	-0.005	-0.077	-0.008	-0.177	-0.026	-0.105	0.726
NUMBER	-0.111	-0.197	0.783	-0.085	-0.110	-0.069	0.102	0.075
MEDHRS	-0.060	0.059	0.708	-0.113	0.008	0.022	-0.181	0.026
NONMHRS	-0.139	0.047	0.139	0.132	-0.064	0.403	0.331	-0.139
PROFHRS	0.054	0.094	0.028	0.035	-0.080	0.487	-0.041	-0.076
FAMGP	-0.830	-0.006	0.135	0.003	-0.166	-0.119	0.146	-0.065
SURGERY	0.218	0.090	-0.058	-0.006	-0.063	-0.049	-0.847	0.110
PEDTRCS	0.363	-0.699	-0.009	0.008	-0.399	0.160	0.149	-0.002
OBGYN	0.078	-0.227	-0.032	-0.017	0.845	-0.165	0.038	0.050
INTRNST	0.386	0.668	-0.067	0.010	-0.143	0.180	0.394	-0.059
BCERT	0.759	-0.116	0.057	-0.029	0.077	0.048	-0.208	-0.030
SIZE	0.526	0.017	0.143	0.026	0.005	-0.138	0.262	-0.002
CNTYINC	0.016	-0.087	-0.276	-0.170	0.094	0.768	0.129	0.145
PHYSSQM	-0.049	-0.034	-0.105	0.614	0.059	0.619	0.033	0.071
PHYSPOP	0.132	-0.076	-0.149	0.643	0.112	0.526	0.060	0.111
AGED	-0.015	0.042	-0.042	0.862	-0.046	-0.083	-0.095	-0.017
STYLES	(iii)	(iv)	(i)		(iii)	(v)		(ii)

Table 4.6: Percentage of Variance Explained by Each Factor (Practice Attribute and Early Career Choice Variables, 1976 Data)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.930	13.3	13.3	AIDPRMD	0.448
2	2.126	9.7	23.0	NETINC	0.643
3	1.994	9.1	32.0	FEEOFF	0.640
4	1.599	7.3	39.3	BLKPAT	0.717
5	1.464	6.7	46.0	NOINS	0.390
6	1.422	6.5	52.4	MDCARE	0.749
7	1.236	5.6	58.1	MDCAID	0.709
8	1.145	5.2	63.3	NUMBER	0.749
9	1.052	4.8	68.0	MEDHRS	0.650
10	0.880	4.0	72.0	NONMHRS	0.492
11	0.853	3.9	75.9	PROFHRS	0.603
12	0.838	3.8	79.7	FAMGP	0.732
13	0.771	3.5	83.2	SURGERY	0.870
14	0.643	2.9	86.2	PEDTRCS	0.867
15	0.606	2.8	88.9	OBGYN	0.900
16	0.543	2.5	91.4	INTRNST	0.891
17	0.537	2.4	93.8	BCERT	0.534
18	0.456	2.1	95.9	SIZE	0.427
19	0.340	1.5	97.4	CNTYINC	0.646
20	0.330	1.5	98.9	PHYSSQM	0.795
21	0.235	1.1	100.0	PHYSPOP	0.816
22	0.000	0.0	100.0	AGED	0.700

Table 4.7: Varimax Rotated Factor Matrix (Practice Attribute and Early Career Choice Variables, 1976 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
AIDPRMD	-0.050	0.642	-0.083	0.036	-0.127	0.070	0.025	-0.045	-0.034
NETINC	-0.029	0.645	0.292	0.307	0.194	0.031	-0.055	-0.049	-0.046
FEEOFF	0.564	-0.109	0.226	0.425	-0.003	0.191	-0.006	0.048	-0.199
BLKPAT	0.059	-0.015	0.023	0.062	-0.054	-0.044	0.829	0.042	-0.127
NOINS	-0.085	-0.168	-0.074	-0.100	-0.420	-0.305	0.004	0.137	0.225
MDCARE	-0.012	-0.036	-0.247	-0.087	0.373	0.686	-0.086	0.099	0.228
MDCAID	-0.048	0.028	-0.060	-0.087	0.058	0.037	0.823	-0.024	0.112
NUMBER	-0.142	0.802	-0.130	-0.193	-0.030	-0.126	0.031	0.045	0.104
MEDHRS	0.003	0.530	0.083	-0.025	0.113	-0.007	-0.027	0.580	0.109
NONMHRS	-0.009	-0.048	-0.249	0.063	0.018	0.034	0.080	0.623	-0.165
PROFHRS	0.094	-0.050	0.198	-0.061	-0.053	0.041	-0.046	0.725	0.128
FAMGP	-0.141	0.135	-0.802	-0.093	-0.071	-0.087	-0.117	-0.017	0.121
SURGERY	-0.047	-0.126	0.167	-0.115	0.889	-0.110	0.025	0.062	0.067
PEDTRCS	0.072	-0.044	0.382	-0.617	0.403	-0.388	0.058	-0.040	-0.126
OBGYN	0.023	0.030	0.197	0.865	-0.191	-0.273	-0.003	-0.037	-0.013
INTRNST	0.105	-0.008	0.113	-0.060	-0.202	0.903	0.047	0.037	-0.058
BCERT	0.095	-0.025	0.656	0.026	0.200	-0.157	-0.091	0.088	-0.110
SIZE	-0.132	0.213	0.490	0.031	-0.134	0.067	-0.116	-0.133	0.264
CNTYINC	0.593	-0.142	0.153	0.001	-0.035	0.097	-0.172	0.095	-0.449
PHYSSQM	0.859	0.013	-0.073	-0.041	0.024	-0.018	0.044	0.012	0.216
PHYSPOP	0.893	-0.106	0.066	-0.024	-0.012	0.009	0.045	0.019	-0.014
AGED	0.050	0.007	-0.047	-0.001	0.007	0.059	-0.030	0.040	0.830
STYLES		(i)	(iii)	(iii)	(iv)	(iv)	(ii)	(v)	

The early career choice decisions and all the exogeneous variables subsequently affect the style of practice. These relationships may be generated by simple axiomatic constraints (the patients of pediatricians are young), more complex constraints which have not achieved axiomatic status (patients of family practice specialists are less likely to be insured for the treatment he provides than are patients of internists) or they may reflect different resources and tastes among physicians with different exogenous characteristics. For example, physicians with large incomes outside the practice may see fewer patients per week than may physicians with less outside income. Both types of physician may have similar utility functions; increased outside income simply expands the feasible set of choices. Despite differences among physicians we expect physicians who make similar early career decisions and who have similar values of the exogenous variables to adopt similar practice styles.

This model assumes that early career decisions, including choice of specialty, "cause" the practice attribute variables and there is no feedback from the practice attribute variables to choice of specialty. However, some physicians may elect a certain specialty because of the associated style of practice. For example, a physician may choose to be a pediatrician because he prefers to see younger patients than medicare patients. Thus, one might postulate that anticipated practice style "causes" specialty. However, this is an insufficient justification to postulate a causal relationship from actual practice style to specialty.

Formal representation of the model requires modification of the model described in Chapter 3, section e. The model represented by Figure 2 is a

Table 4.8: Varimax Rotated Factor Matrix (1975 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
AIDPRMD	0.610	-0.073	0.223	-0.106	-0.106	-0.122
NETINC	0.521	-0.015	0.557	0.014	-0.193	-0.157
FEEOFF	-0.064	0.102	0.800	-0.038	0.053	0.045
BLKPAT	-0.074	-0.091	0.225	0.724	-0.113	-0.182
NOINS	-0.040	-0.756	-0.101	-0.129	0.102	0.039
MDCARE	-0.068	0.760	-0.013	-0.119	0.111	0.071
MDCAID	0.093	0.099	-0.253	0.751	0.082	0.069
NUMBER	0.804	-0.163	-0.097	0.107	-0.007	0.023
MEDHRS	0.714	0.171	-0.122	0.059	0.154	-0.031
NONMHRS	0.001	0.011	-0.035	-0.051	0.868	-0.083
PROFHRS	-0.095	-0.039	0.362	0.178	0.412	0.576
MALE	0.419	0.112	0.021	-0.156	0.001	0.444
EXPER	-0.229	-0.009	-0.173	-0.125	-0.313	0.666
STYLES	(i)	(iv)	(iii)	(ii)	(v)	

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	2.142	16.5	16.5
2	1.359	10.5	26.9
3	1.276	9.8	36.7
4	1.218	9.4	46.1
5	1.102	8.5	54.6
6	0.959	7.4	62.0
7	0.908	7.0	68.9
8	0.824	6.3	75.3
9	0.797	6.1	81.4
10	0.753	5.8	87.2
11	0.681	5.2	92.4
12	0.538	4.1	96.6
13	0.444	3.4	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.465
NETINC	0.644
FEEOFF	0.660
BLKPAT	0.635
NOINS	0.613
MDCARE	0.614
MDCAID	0.658
NUMBER	0.695
MEDHRS	0.583
NONMHRS	0.765
PROFHRS	0.675
MALE	0.411
EXPER	0.640

Table 4.9: Varimax Rotated Factor Matrix (1976 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
AIDPRMD	0.621	0.015	-0.062	0.090	0.046	-0.136
NETINC	0.658	-0.057	-0.094	-0.358	0.047	0.235
FEEOFF	-0.186	-0.004	0.079	-0.826	0.069	0.040
BLKPAT	-0.041	0.834	0.032	-0.088	-0.140	0.080
NOINS	-0.133	-0.041	0.119	0.316	-0.729	0.075
MDCARE	-0.075	-0.074	0.181	0.186	0.759	0.120
MDCAID	0.044	0.833	0.013	0.088	0.100	-0.100
NUMBER	0.773	0.039	0.043	0.337	-0.034	0.100
MEDHRS	0.556	-0.052	0.585	0.001	0.009	0.088
NONMHRS	-0.071	0.117	0.585	0.080	0.090	-0.035
PROFHRS	-0.039	-0.069	0.758	-0.150	0.044	0.004
MALE	0.101	-0.005	-0.008	-0.063	0.003	0.887
EXPER	-0.421	-0.041	0.008	0.406	0.191	0.451
STYLES	(i)	(ii)	(v)	(iii)	(iv)	

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	2.016	15.5	15.5
2	1.471	11.3	26.8
3	1.354	10.4	37.2
4	1.296	10.0	47.2
5	1.174	9.0	56.2
6	1.016	7.8	64.1
7	0.904	7.0	71.0
8	0.796	6.1	77.1
9	0.739	5.7	82.8
10	0.710	5.5	88.3
11	0.598	4.6	92.9
12	0.536	4.1	97.0
13	0.390	3.0	100.0

VARIABLE	COMMUNALITY
AIDPRMD	0.419
NETINC	0.631
FEEOFF	0.729
BLKPAT	0.732
NOINS	0.671
MDCARE	0.668
MDCAID	0.724
NUMBER	0.725
MEDHRS	0.662
NONMHRS	0.377
PROFHRS	0.605
MALE	0.801
EXPER	0.584

Table 4.10: Percentage of Variance Explained by Each Factor (All Variables, 1975 Data)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.868	12.5	12.5	AIDPRMD	0.581
2	2.361	10.3	22.7	NETINC	0.558
3	2.050	8.9	31.6	FEEOFF	0.553
4	1.727	7.5	39.2	BLKPAT	0.599
5	1.445	6.3	45.4	NOINS	0.349
6	1.346	5.9	51.3	MDCARE	0.688
7	1.285	5.6	56.9	MDCAID	0.528
8	1.070	4.7	61.5	NUMBER	0.683
9	0.992	4.3	65.8	MEDHRS	0.522
10	0.936	4.1	69.9	NONMHRS	0.384
11	0.898	3.9	73.8	PROFHRS	0.208
12	0.849	3.7	77.5	FAMGP	0.823
13	0.810	3.5	81.0	SURGERY	0.792
14	0.745	3.2	84.3	PEDTRCS	0.837
15	0.699	3.0	87.3	OBGYN	0.796
16	0.586	2.5	89.9	INTRNST	0.850
17	0.510	2.2	92.1	BCERT	0.625
18	0.475	2.1	94.1	CNTYINC	0.701
19	0.418	1.8	96.0	PHYSSQM	0.786
20	0.380	1.7	97.6	PHYSPOP	0.760
21	0.329	1.4	99.0	AGED	0.766
22	0.221	1.0	100.0	MALE	0.359
23	0.000	0.0	100.0	EXPER	0.403

Table 4.11: Varimax Rotated Factor Matrix (All Variables, 1975 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
AIDPRMD	-0.106	0.037	0.628	0.017	-0.030	-0.009	-0.414	-0.031
NETINC	-0.058	0.329	0.597	0.045	0.285	0.085	0.010	0.010
FEEOFF	0.289	0.290	0.087	0.257	0.538	-0.030	-0.078	-0.122
BLKPAT	-0.006	0.176	0.006	0.031	0.159	0.024	-0.013	0.736
NOINS	0.027	-0.097	-0.018	-0.472	-0.036	0.284	-0.177	-0.050
MDCARE	0.042	-0.106	-0.042	0.791	-0.197	0.092	-0.017	-0.018
MDCAID	-0.016	-0.137	0.100	0.023	-0.195	-0.021	0.177	0.655
NUMBER	-0.104	-0.150	0.767	-0.203	-0.092	-0.059	-0.077	0.042
MEDHRS	-0.044	-0.081	0.682	0.070	0.019	-0.115	0.175	0.023
NONMHRS	0.479	-0.127	0.133	0.048	-0.078	-0.067	0.323	-0.057
PROFHRS	0.412	0.089	-0.006	0.096	-0.103	0.000	-0.030	-0.088
FAMGP	-0.076	-0.882	0.105	-0.014	-0.135	0.031	-0.019	-0.090
SURGERY	-0.043	0.297	-0.051	0.138	-0.081	0.046	0.815	0.084
PEDTRCS	0.102	0.354	-0.018	-0.728	-0.371	-0.057	-0.173	0.015
OBGYN	-0.153	0.089	-0.030	-0.186	0.847	-0.018	-0.027	0.101
INTRNST	0.165	0.376	-0.035	0.627	-0.186	-0.013	-0.497	-0.066
BCERT	0.020	0.757	0.075	-0.111	0.080	-0.036	0.154	-0.052
CNTYINC	0.673	0.024	-0.294	-0.065	0.084	-0.369	-0.088	0.078
PHYSSQM	0.781	-0.032	-0.102	-0.073	0.060	0.379	-0.040	0.105
PHYSPOP	0.696	0.138	-0.136	-0.117	0.116	0.436	-0.066	0.126
AGED	0.168	0.009	-0.023	-0.016	-0.039	0.855	0.045	0.041
MALE	-0.047	0.076	0.344	0.151	-0.130	0.036	0.191	-0.394
EXPER	-0.098	-0.248	-0.308	0.020	0.034	0.404	0.012	-0.269
STYLES	(v)		(i)	(iv)	(iii)			(ii)

Table 4.12: Percentage of Variance Explained by Each Factor (All Variables, 1976 Data)

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT	VARIABLE	COMMUNALITY
1	2.946	12.3	12.3	AIDPRMD	0.459
2	2.224	9.3	21.5	NETINC	0.641
3	2.070	8.6	30.2	FEEOFF	0.648
4	1.633	6.8	37.0	BLKPAT	0.743
5	1.466	6.1	43.1	NOINS	0.444
6	1.428	6.0	49.0	MDCARE	0.748
7	1.309	5.5	54.5	MDCAID	0.714
8	1.145	4.8	59.3	NUMBER	0.749
9	1.065	4.4	63.7	MEDHRS	0.652
10	1.018	4.2	67.9	NONMHRS	0.516
11	0.892	3.7	71.7	PROFHRS	0.600
12	0.857	3.6	75.2	FAMGP	0.715
13	0.820	3.4	78.6	SURGERY	0.855
14	0.788	3.3	81.9	PEDTRCS	0.848
15	0.743	3.1	85.0	OBGYN	0.876
16	0.621	2.6	87.6	INTRNST	0.882
17	0.567	2.4	90.0	BCERT	0.535
18	0.538	2.2	92.2	SIZE	0.468
19	0.525	2.2	94.4	CNTYINC	0.631
20	0.449	1.9	96.3	PHYSSQM	0.798
21	0.336	1.4	97.7	PHYSPOP	0.820
22	0.327	1.4	99.0	AGED	0.733
23	0.234	1.0	100.0	MALE	0.654
24	0.000	0.0	100.0	EXPER	0.578

Table 4.13: Varimax Rotated Factor Matrix (All Variables, 1976 Data)

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
AIDPRMD	-0.050	0.638	-0.121	0.045	-0.056	0.062	0.003	-0.043	-0.031	-0.150
NETINC	-0.267	0.637	0.309	0.286	0.193	0.025	-0.042	-0.051	-0.048	0.115
FEEOFF	0.547	-0.106	0.208	0.456	0.058	0.208	-0.007	0.058	-0.173	-0.074
BLKPAT	0.069	-0.018	0.021	0.058	-0.072	-0.031	0.836	0.031	-0.152	0.067
NOINS	-0.071	-0.153	-0.032	-0.100	-0.530	-0.242	0.030	0.111	0.171	0.150
MDCARE	-0.001	-0.042	-0.232	-0.157	0.399	0.633	-0.080	0.092	0.236	0.192
MDCAID	-0.052	0.024	-0.068	-0.082	0.065	0.031	0.818	-0.018	0.125	-0.096
NUMBER	-0.132	0.799	-0.107	-0.211	-0.066	-0.128	0.038	0.037	0.084	0.081
MEDHRS	0.002	0.528	0.098	-0.033	0.090	-0.012	-0.020	0.583	0.115	0.029
NONMHRS	-0.017	-0.049	-0.277	0.071	0.053	0.022	0.066	0.632	-0.139	0.068
PROFHRS	0.103	-0.054	0.199	-0.069	-0.092	0.052	-0.040	0.717	0.106	0.060
FAMGP	-0.141	0.154	-0.754	-0.123	-0.121	-0.082	-0.100	-0.029	0.124	0.199
SURGERY	-0.051	-0.132	0.213	-0.170	0.831	-0.192	0.039	0.079	0.108	0.113
PEDTRCS	0.074	-0.045	0.366	-0.545	-0.438	-0.343	0.046	-0.034	-0.158	-0.269
OBGYN	0.021	0.021	0.149	0.874	-0.147	-0.256	-0.015	-0.041	-0.015	-0.015
INTRNST	0.108	-0.012	0.080	-0.055	-0.099	0.918	0.040	0.031	-0.067	-0.040
BCERT	0.111	-0.041	0.649	0.018	0.173	-0.175	-0.089	0.086	-0.142	0.062
SIZE	-0.128	0.205	0.520	0.037	-0.184	0.107	-0.094	-0.139	0.242	0.072
CNTYINC	0.580	-0.138	0.143	0.042	0.004	0.116	-0.173	0.105	-0.434	-0.102
PHYSSQM	0.863	0.016	-0.063	-0.044	0.004	-0.020	0.046	0.008	0.208	0.026
PHYSPOP	0.895	-0.106	0.066	-0.011	-0.016	0.015	0.046	0.017	-0.024	0.002
AGED	0.046	0.003	-0.057	-0.005	0.006	0.037	-0.044	0.049	0.847	-0.068
MALE	-0.105	0.129	0.097	0.126	0.003	0.071	0.013	0.037	0.019	0.771
EXPER	0.117	-0.284	-0.246	-0.174	0.023	-0.056	-0.061	-0.049	-0.112	0.608
STYLES	(iii)	(i)		(iii)	(iv)	(iv)	(ii)	(v)		

block recursive model. There are two sets (blocks) of endogenous variables: five practice styles and ten early career choice variables. Suppose we partition η such that $\eta' = [\eta_s' \; \eta_c']$ where $\eta_s(5\times1)$ denotes the vector of latent styles and $\eta_c(10\times1)$ denotes the vector of early career choice variables.[17] Similarly, we partition y such that $y' = [y_s' \; y_c']$ where $y_s(12\times1)$ is a vector of observed practice attribute variables and $y_c(10\times1)$ is a vector of early career choice variables. We assume that the early career choice variables are measured without error, $\eta_c = y_c$. Also, we assume that the exogenous variables are measured without error, $\xi = x$. We partition the exogenous variables such that $x' = [x_s' \; x_c']$ where x_s (2x1) represents the exogenous physician characteristics, experience and over ten thousand dollars outside income, that directly affect the styles but do not affect the early career choice variables, and x_c (2x1) denotes the exogenous variables, race and sex, that directly affect the practice styles and early career choice variables. Finally $\zeta' = [\zeta_s' \; \zeta_c']$ where $\zeta_s(5\times1)$ represents the errors in the practice style equations and $\zeta_c(10 \times 1)$ represents the errors in the early career choice equations. Now we can write the block recursive model depicted in Figure 4.1:

$$y_s = \Lambda_{ys}\eta_s + \varepsilon_s \tag{4.1}$$

$$\begin{bmatrix} I_s & -\beta_{sc} \\ 0 & I_c \end{bmatrix} \begin{bmatrix} \eta_s \\ y_c \end{bmatrix} = \begin{bmatrix} \Gamma_{ss} & \Gamma_{sc} \\ 0 & \Gamma_{cc} \end{bmatrix} \begin{bmatrix} x_s \\ x_c \end{bmatrix} + \begin{bmatrix} \zeta_s \\ \zeta_c \end{bmatrix} \tag{4.2}$$

---

[17] These and subsequent dimensions pertain to the 1975 data.

where Λ_{ys} is a matrix of factor loadings, the nonsingular parameter matrix β_{sc} (5x10) represents the effects of the ten early career choice variables on each of the five practice styles, Γ_{ss} (5x2) represents the effects of experience and over ten thousand dollars outside income on the styles, Γ_{sc} (5x2) and Γ_{cc} (10x2) represent the effects of race and sex on the practice styles and early career choice variables, respectively. I_s (5x5) and I_c (10x10) denote identity matrices: Practice styles are assumed to be causally unrelated to one another and the early career choice variables are assumed to be causally unrelated to one another. ζ_s (5x1) represents a random vector of disturbances in the practice style equations and ζ_c (10x1) represents the errors in the early career choice equations, ψ_s and ψ_c represent the variance-covariance matrices of ζ_s are ζ_c, respectively. We assume the off - diagonal elements equal zero.

The model is estimated by Jöreskog's (1973) maximum likelihood method. Input to the computer program consists of the correlation matrix: All observed variables have zero mean and unit variance. Furthermore, it is assumed that all errors in variables and errors in equations have zero mean.

d) Results

The major purpose of the exploratory research was to determine which elements of Λ_{ys} should be set equal to zero. Initially, equation (4.2) was ignored and equation (4.1) was estimated by factor analysis and maximum likelihood factor analysis with all elements of Λ_{ys} free. For estimation of the causal model, equations (4.1) and (4.2), large parameter estimates of

Λ_{ys} were set free and were estimated while small loadings were set equal to zero.[18] All other parameter matrices were set free.

The pattern of results in Table 4.14 corresponds exactly to that obtained in the preliminary analyses and to the five practice styles described previously. For identification purposes one parameter in each column was set equal to unity in the unstandardised solution. All of the reported results are for the standardized solution in which the variance of each latent variable equals unity. T-statistics appear in parenthesis below each estimated parameter. All of the estimated free parameters are very significant, although some error variances are quite high.

Table 4.15 presents the estimated matrix using the 1976 data. The manifest variables are similar with some minor exceptions. In 1976 physicians did not indicate their patients' income levels, but they did indicate their patients' race. The percentage of black patients substituted for the percentage of low income patients as an indicator of style ii. No indication of the regional price level was available in 1976 to standardize fees or net income. All coefficients are significant and, are of approximately the same magnitude as those obtained using the 1975 data.

We focus now on the determinants of each style as suggested by the estimated parameter matrix β_{sc}, which measures the effects of early career choice on practice styles, and Γ_{ss} and Γ_{sc} which measure the effects of the exogenous variables on practice styles. These results are reported in Tables 4.16 and 4.17 for the 1975 and 1976 data, respectively.

---

[18] At this stage of the research, we felt that aides' hours per physician (AIDHRMD) was a better measurement than aides per physician (AIDPRMD).

The Effects of Early Career Choice Variables (β_{SC}) on Practice Styles

The specialty coefficients measure the difference between the intercept for that specialization and the intercept for surgeons which was the omitted dummy variable. Most relationships are consistent with what is generally known about physicians' practices, as reported in the A.M.A.'s Periodic Survey of Physicians (A.M.A., 1976, 1977). Pediatricians are the least likely specialists to treat Medicare patients which is confirmed by the large negative coefficient for pediatricians in the equation for geriatric, hospital based physicians - style iv. Similarly, obstetricians and gynecologists are unlikely to adopt this style. Internists, on the other hand, more often serve as consultants for complicated cases than other specialists and more often see patients with severe problems (Aiken et al., 1979). To the extent that the elderly have more severe problems than the young and require hospitalization more often, internists are more involved in the hospital care required by the elderly, and the coefficient for internists with a geriatric, hospital practice (style iv) is positive and very significant.

According to the coefficients obstetricians and gynecologists are more likely than other physicians to have expensive, prosperous practices, which is consistent with the A.M.A.'s report (1976, 1977) that these physicians have higher office fees than do other physicians. Family and general practice physicians and pediatricians are less likely to have this type of practice. The significant difference between the coefficients for internists and FP/GP specialists supports the argument suggested by Steinwald and Sloan (1974) and others that affluent patients substitute internists for FP/GP physicians. At the same time, according to Aitken et al. (1979) internists generally treat

more severe cases for which they can charge higher fees than do FP/GP physicians.

Family and general practice physicians are more likely than other physicians to adopt style i -- to see many patients, use aides extensively and spend many hours at their practice. The 1975 data suggest that pediatricians are significantly more likely to adopt this style than are surgeons but in the 1976 data this difference is not significant.

For styles (ii) -- low income, Medicaid patients -- and style (v) -- academic or administrative physicians -- differences among the specialties are less significant than the results reported for the other styles. The only consistent, statistically significant result is that obstetricians and gynecologists, and pediatricians to some extent, are least likely to adopt style (v).

Board-certified physicians are most likely than noncertified physicians to adopt styles (iii) and (iv). The negative coefficient of board-certification in the style ii equation implies that board certified physicians are less likely to treat a high percentage of low-income, Medicaid patients than non-board certified physicians. While Davis and Schoen (1978) find that utilization of physician services by low income patients now equals or exceeds that of higher income patients, they do not control the quality of care. If board certification is an indicator of treatment quality our results suggest that low-income, Medicaid patients may not receive the same quality of treatment as do higher income patients, or patients on Medicare or with other types of insurance.

The results for practice size indicate that larger practices are associated with styles (i) and (iii), both of which are high net income styles. Smaller practices are associated with styles (ii) and (v). As expected, the greater the percentage the population over 65 years of age, the more prevalent is style (iv) -- physicians who treat Medicare and other insured patients. For the 1975 data, however, neither the number of physicians in the practice nor the percent of the population over age 65 is strongly associated with any style.

The coefficients of per-capita county income and physicians per square mile are of particular interest. One might expect that, ceteris paribus, an increase in the number of physicians (sellers) would lead to a reduction in the average number of services per physician and to a reduction in fees. In practice, however, fees are generally higher in areas with high numbers of physicians per capita than in areas with few physicians per capita. Proponents of this theory should recognize first that if one measures fee for service the relevant quantity measure is number of services or number of services per physician, not the number of physicians. Second, in certain circumstances an increase in the number of physicians per capita may lead to increased fees. Reducing the number of patients seen by a physician may lead to some upward pressure on fees because it reduces the time-price of a visit. Furthermore, Evans (1976) and others have argued that physicians may "create" demand for their services.

The following theory of practice organization in relatively overserved and underserved areas is based on a model of competitive monopoly, some components of which may be found in Kehrver and Knowles (1974). Reinhardt

TABLE 4.14: LAMBDA y (Λ_{y_s}) (1975 Data)

	Style					
	(i)	(ii)	(iii)	(iv)	(v)	$\theta^2_{\varepsilon_s}$
AIDHRMD	.590					.682
						(24.42)
NETINC	.557		.506			.546
	(8.05)					(19.05)
FEEOFF			.541			.689
			(7.55)			(23.93)
HIINC			.302			.903
			(5.04)			(29.14)
LOWINC		.814				.345
						(6.24)
NOINS				-.287		.914
				(-5.20)		(29.41)
MDCARE				.726		.495
						(9.71)
MDCAID		.573				.667
		(5.78)				(19.23)
NUMBER	.715					.448
	(9.42)					(17.25)
MEDHRS	.499					.731
	(7.89)					(26.47)
NONMHRS					.481	.781
						(14.19)
PROFHRS					.261	.939
					(2.98)	(27.53)

TABLE 4.15: LAMBDA y (Λ_{y_s}) (1976 Data)

	Style					
	(i)	(ii)	(iii)	(iv)	(v)	$\theta^2_{\varepsilon_s}$
AIDHRMD	.575					.778
						(38.68)
NETINC	.624		.433			.581
	(12.42)					(30.10)
FEEOFF			.588			.646
			(11.93)			(31.79)
BLKPAT		.898				.199
						(1.56)
NOINS				-.191		.962
				(-5.14)		(45.44)
MDCARE				.836		.303
						(5.64)
MDCAID		.450				.796
		(3.12)				(21.86)
NUMBER	.755					.434
	(13.70)					(23.37)
MEDHRS	.417					.826
	(10.14)					(42.46)
NONMHRS					.355	.885
						(24.32)
PROFHRS					.220	.925
					(2.69)	(39.44)

Table 4.16: STRUCTURAL FORM PARAMETERS(1975 Data)
(t-statistics in paratheses)

BETA (B_{sc})

Style	FAMGP	PEDTRCS	OBGYN	INTRNST	BCERT	SIZE	AGED	CNTYINC	PHYSSQM
(i)	.346	.229	.098	.071	.025	.017	-.060	-.152	-.155
	(3.92)	(3.32)	(1.44)	(.95)	(.38)	(.32)	(-.96)	(-2.55)	(-2.58)
(ii)	-.088	-.047	-.020	-.144	-.161	-.005	-.054	-.177	.094
	(-1.04)	(-.69)	(-.30)	(-1.92)	(-2.48)	(-.10)	(-.86)	(-2.98)	(1.58)
(iii)	-.533	-.328	.119	-.015	.130	.112	-.011	.153	.198
	(-5.14)	(-4.14)	(1.59)	(-.19)	(1.83)	(1.84)	(-.16)	(2.32)	(2.95)
(iv)	-.009	-.637	-.399	.331	.111	-.071	.034	.016	-.001
	(-.11)	(-9.62)	(-6.01)	(4.55)	(1.77)	(-1.32)	(.56)	(.28)	(-.02)
(v)	-.156	-.170	-.226	-.024	.023	-.141	.144	.058	.390
	(-1.11)	(-1.51)	(-1.98)	(-.19)	(.22)	(-1.53)	(1.39)	(.59)	(3.83)

GAMMA (Γ_{ss} Γ_{sc})

Style	EXPER	OVER10	WHITE	MALE	Ψ_s	R^2
(i)	-.255	.013	.043	.186	.765	.235
	(-4.31)	(.24)	(.81)	(3.37)	(5.58)	
(ii)	-.023	-.002	-.336	.115	.814	.186
	(-.41)	(-.03)	(-6.14)	(2.12)	(4.73)	
(iii)	-.014	.330	.058	.079	.331	.669
	(-.22)	(5.22)	(1.00)	(1.34)	(2.74)	
(iv)	.056	-.007	-.067	-.084	.291	.709
	(1.02)	(-.14)	(-1.29)	(-1.61)	(1.58)	
(v)	-.135	-.022	-.133	.042	.668	.332
	(-1.43)	(-.25)	(-1.50)	(.47)	(1.58)	

Table 4.17: STRUCTURAL FORM PARAMETERS(1976 Data)
(t-statistics in paratheses)

BETA (B_{sc})

Style	FAMGP	PEDTRCS	OBGYN	INTRNST	BCERT	SIZE	AGED	CNTYINC	PHYSSQM
(i)	.208	.066	.012	.019	.038	.132	.012	-.300	-.044
	(4.22)	(1.48)	(.28)	(.43)	(.98)	(3.70)	(.33)	(-7.37)	(-1.22)
(ii)	-.075	.072	.042	.017	-.064	-.097	-.111	-.094	.062
	(-1.56)	(1.61)	(.95)	(.39)	(-1.68)	(-2.78)	(-3.16)	(-2.54)	(1.73)
(iii)	-.311	-.335	.272	.070	.167	.091	-.080	.501	.251
	(-5.60)	(-6.47)	(5.46)	(1.48)	(3.98)	(2.40)	(-2.11)	(9.74)	(6.10)
(iv)	-.055	-.609	-.494	.242	.084	-.038	.176	-.006	-.006
	(-1.45)	(-17.18)	(-14.08)	(6.92)	(2.76)	(-1.36)	(6.30)	(-.22)	(-.22)
(v)	.105	-.171	-.193	.039	.089	-.166	.089	.226	.077
	(.98)	(-1.70)	(-1.92)	(.40)	(1.04)	(-2.09)	(1.14)	(2.64)	(.96)

GAMMA (Γ_{ss} Γ_{sc})

Style	EXPER	OVER10	WHITE	MALE	Ψ_s	R^2
(i)	-.202	-NA-	-NA-	.102	.778	.222
	(-5.47)	-NA-	-NA-	(2.87)	(7.97)	
(ii)	-.019	-NA-	-NA-	.005	.961	.039
	(-.56)	-NA-	-NA-	(.15)	(3.02)	
(iii)	-.114	-NA-	-NA-	.073	.083	.917
	(-2.98)	-NA-	-NA-	(1.94)	(.97)	
(iv)	.104	-NA-	-NA-	-.021	.328	.672
	(3.72)	-NA-	-NA-	(-.76)	(2.14)	
(v)	.012	-NA-	-NA-	.004	.820	.180
	(.15)	-NA-	-NA-	(.05)	(1.66)	

(1975) showed that the supply of physicians is positively related to per capita income in an area. Income also positively affects the consumer's purchase of health insurance (Phelps, 1976). Thus, areas with many physicians tend to be areas of high per capita income and more extensive insurance coverage. We believe these differences are further increased by the type of physician services delivered in overserved areas. To the extent that these services are less likely to be provided in the home or office, insurance coverage will be even more extensive (Carroll and Arnett, 1979).

These two factors, insurance and income, affect the demand for physician services. Increased insurance lowers the effective price to the consumer of an office visit and increases demand through a price (substitution) effect. Higher income increases demand through a pure income effect. Thus there is upward pressure on fees in over-served areas. These upward pressures pertain to total demand or to demand per capita. The demand for a particular physician's services depends on the number of physicians per capita, as well his price and the prices of other physicians' services.

Insurance and income also affect the price sensitivity of demand.[19] Increased insurance coverage reduces the price-sensitivity of demand by reducing out-of-pocket costs and higher income reduces price-sensitivity by reducing the importance of money-price versus time-price of the visit. In addition, as Pauly and Satterthwaite (1978) argue, in communities with many physicians the amount of information each consumer possesses about sellers' price and quality decreases which leads to less efficient search on the part of consumers. As search becomes less efficient, each physician's demand may become less price elastic and the price he charges rises. Owens (1980)

---

[19] We prefer "price-sensitivity" to price elasticity in this case. Price elasticity, defined as $\varepsilon = (-P/Q)(dQ/dP)$ (where P is price and Q is quantity demanded) decreases as the slope of the demand curve, d/P/dQ increases, or as curve of constant slope shifts away from the P (vertical) axis. We refer to changes in elasticity due to changes in slope as price-sensitivity.

provides interesting anecdotal evidence on ways in which high-fee physicians view the price sensitivity of demand for their services.

Rosenthal (1980) examines a different setting in which an increase in competition among sellers leads unambiguously to a higher price. As an illustration of his argument, suppose that each physician has a number of loyal patients who purchase their medical services only from that physician, although the demand may decrease as price increases. At the same time there are a group of patients who will purchase only from the lowest priced physician(s). Each physician has monopoly power over one class of buyers but does not over the others, and he is unable to impose a different price on the two classes. Rosenthal uses a static game among sellers' model in which the pure strategies are priced to show the price is higher after new sellers enter.

These effects may be summarized as follows. Whereas utilization of all physicians' services per capita is higher in areas of many physicians/capita, the utilization per physician actually decreases as population increases. For example, the annual rate of visits to office-based family practice specialists and general practitioners per capita in 1975 was fifty percent higher in S.M.S.A. than non-S.M.S.A. areas (H.E.W., 1977). This increase in visits per capita is somewhat offset by an increase in physicians of this specialty per capita in non-S.M.S.A. areas (A.M.A., 1973), but these physicians must also absorb some demand that would be met by specialists of other types in S.M.S.A. areas. The net result is a dramatic increase in the average physician's workload in underserved areas. Moreover, by the arguments presented above, this high volume of demand per physician is relatively more

sensitive to changes in price. The increased price-sensitivity of demand tends to keep prices low relative to overserved areas (even after cost of living corrections). However, physician net incomes in overserved areas remain below those physicians in underserved areas due to differences in the number of patients seen.

This discussion suggests that fees will be higher and individual physicians' workloads will be lower in areas with high average incomes and high numbers of physicians per capita. (In practice we use physicians per square mile, rather than physicians per capita because of the arguments made by Pauly and satterthwaite.) Consequently we would expect average county income and physicians per square mile to have positive coefficients in the style three equation. As a corollary the discussion suggests that fees will be lower and individual physician workloads higher in areas with low average incomes and few physicians per square mile. Consequently we would expect average county income and physicians per square mile to have negative coefficients in the style one equation. The coefficients in Tables 4.16 and 4.17 are consistent with this theory. Style (i) physicians tend to be found in areas of few physicians per square mile and low per capita county income. They are family practice specialists, general practitioners and pediatricians for the most part. They work long hours and see many patients at average fees, but maintain high net incomes due to high patient volume (A.M.A., 1976, 1977).

Style iii physicians, on the other hand, are most likely to be found in areas of high per capita income and high physicians per square mile.[20] The higher income of these areas applies not only to the average per capita of the county in which the practice is located but directly influences the percentage of the physician's own patients who have high incomes. The high fees of style iii partially offset the reduction in income due to the lower volume of patients seen by these physicians. However, the loading on net income remains lower for style iii than style i physicians in Table 4.14. This indicated income difference is consistent with the A.M.A. data (A.M.A., 1976, 1977) which show an inverse relationship between physician net income and population for physicians in all five specialty groups (even without corrections for cost of living, which should make the inverse relationship even more pronounced). Of course, the lower net income reflects differences in practice costs as well as in workload. But the A.M.A. data show that physicians in non-metropolitan areas and physicians in metropolitan areas with 50,000-999,999 people had virtually the same annual professional expenses ($37,423 and $37,552,

---

[20] Although style (iii) physicians are associated with high fees, it is possible that the fees of all physicians do not rise uniformly in overserved areas after cost-of-living corrections. Kessel (1958), Rimlinger and Steele (1963) and Mason and Wu (1974) suggest that physicians price discriminate either as a cartel, or individually. It may be that both product differentiation and price discrimination increase among physicians in overserved areas. Physicians in underserved areas may be induced to develop regionally homogeneous practice styles by high patient-initiated demand (perhaps relatively homogeneous in character) and demand that is relatively sensitive to price. Physicians in overserved areas faced with lower patient-initiated demand and lower price-sensitivity may have the opportunity, and find it in their best interest, to differentiate their product from other physicians in the area by spending more or less time with patients, reducing or increasing office waiting time or time to appointment, and charging fees which reflect this product differentiation. Reimbursement policies, scheduling difficulties and the transmission of information to consumers may make it more difficult for the individual physician to practice price discrimination and product differentiation than for the physician community in aggregate. Both strategies may manifest themselves in the physician's style of practice.

respectively) in 1974 and physician's expenses in metropolitan areas over 1,000,000 actually had lower annual expenses ($33,162). Thus the reduced net income would appear to be due, at least in part, to reduced workload.

The influence of regional demographic characteristics on the physician's own patient mix is seen again in the negative coefficient of per capita county income on low income patient practices (style ii). The high, positive coefficient of physicians per square mile on style v -- academic or administrative practices, is consistent with the findings of Wilson, et al. (1979).

The Direct Effects of the Exogenous Variables ($\Gamma_{\underline{ss}}\,\Gamma_{\underline{sc}}$) on Practice Styles

The gamma coefficients, which appear in Tables 4.16 and 4.17, measure the direct effect of the exogenous variables on practice styles. For both years data are available on the physicians experience and sex, but for 1976 no datum is available on the physician's outside income and race. Both datasets suggest that male physicians and less experienced (and thus younger) physicians are more likely to have busy, successful ambulatory care practices (style i). Sloan (1975) finds that female physicians have traditionally devoted less time to their practices than have male physicians and this probably explains why they are less well represented in this relatively active and timeconsuming practice style. Similarly, Sloan (1975) finds the older, more experienced physicians restrict their practice activity which leads one to expect they also would be less well represented in this practice style. The other coefficients of experience and male are less significant.

The 1975 data suggest that physicians with large outside incomes are more likely to have expensive, prosperous practices (style iii) than to adopt any other style. There are several possible explanations for this. Prosperous practices generate income which can be invested profitably outside the practice to generate additional income. Physicians who can rely on outside income to supplement their practice income can more easily restrict their practices to fewer patients and may possess more entrepreneurial drive needed to attract affluent patients and to run efficient practices.

Also in the 1975 data there is a strong relationship between non-white physicians and practices characterized by low income and Medicaid patients (style ii). Our findings suggest that non-white physicians are more likely to treat low income patients than are white physicians. If our assumptions are correct and exogenous variables such as race determine the choice of practice style, this means non-white physicians choose practices with low-income patients more often than do white physicians.

The Effects of the Exogenous Variables

The effects of the appropriate, exogenous variables on the early career choice variables appear in Table 4.19. While all equations have poor fits, most of the results are consistent and informative. For both years the results suggest that males are more likely than females to become FP/GP specialists and females are more likely than males to become pediatricians. While the 1975 data suggests males are less likely than females to become obstetrician-gynecologists, and this is not supported by the 1975 data. Similarly, the 1975 data suggests males are more likely than females to become internists and this is not supported by the 1976 data. Both years of

data suggest that males are more likely than females to become board certified, to work in a large practice, and to work in areas with few physicians per square mile, low average income and a high percentage of older patients.

The effects of race on the early career choice variables can be studied only for 1975. White physicians are more likely than others to become family practice-general practice specialists, surgeons or internists than to become pediatricians, obstetricians or gynecologists. White physicians are more likely than non-white physicians to become board certified, to work in a large practice, and to work in areas with few physicians per square mile, with low average incomes and a high percentage of older patients.

The reduced form coefficients for the exogenous variables (experience, over ten thousand dollars outside income, race and sex) are reported in Table 4.18. A comparison of this table with the gamma matrices in Tables 4.15 and 4.16 shows that the structural form parameters are sufficiently similar to the reduced form parameters to conclude that the indirect effects of the exogenous variables are negligible.

A comparison of the R^2 in Tables 4.16 with Table 4.18 shows that the inclusion of the early career choice variables significantly increases the explanatory power of the model. For styles iii and iv the R^2 increase by 0.51 and 0.69, respectively, with the 1975 data, and by larger amounts with the 1976 data.

Table 4.18: Reduced Form Parameters

Explanatory Variables: 1975 Data

Style	EXPER	OVER10	WHITE	MALE	R^2
(i)	-.218	-.022	.038	.208	.093
(ii)	.011	-.014	-.338	.094	.117
(iii)	-.155	.388	.071	.060	.155
(iv)	.077	.056	-.063	.071	.016
(v)	-.133	.008	-.158	-.003	.051

Explanatory Variables: 1976 Data

Style	EXPER	OVER10	WHITE	MALE	R^2
(i)	-.228	-NA-	-NA-	.149	.066
(ii)	-.011	-NA-	-NA-	-.018	.001
(iii)	-.179	-NA-	-NA-	.083	.035
(iv)	.203	-NA-	-NA-	.084	.052
(v)	.056	-NA-	-NA-	.006	.003

Table 4.19: Variables Affecting the Early Career Choice Variables: Γcc

	Explanatory variable (1975 Data)			Explanatory variable (1976 Data)	
	White	Male	ψ_c	Male	Ψ_c
FAMGP	.039	.035	.997	.083	.993
SURGERY	-.047	.063	.994	.077	.994
PEDTRCS	-.017	-.107	.988	-.191	.962
OBGYN	-.006	-.119	.986	.028	.999
INTRNST	.010	.086	.992	-.001	.999
BCERT	.011	.061	.996	.016	.999
SIZE	.016	.025	.999	.054	.997
CNTYINC	-.009	-.077	.994	-.081	.993
PHYSSQM	-.005	-.131	.983	-.082	.993
AGED	.023	.016	.999	.028	.999

5. SUMMARY

The process by which physicians organize their practices are generally not well understood, despite rather intensive research efforts in the last decade. Although established theories such as those stemming from microeconomics provide models of production function and output level decisions these models, when tested empirically, are quite limited in their ability to predict observed physician behavior. Two reasons for this lack of success have been discussed.

In models of this type one assumes that there is a basic consistency in the mechanisms which generate the data, that is, utility functions of individuals are roughly of the same form and that two individuals with the same resources, facing the same constraints will be observed to make similar consumption and production decisions. Individual variances in utility functions are assumed to be small relative to the general consistencies in the functions. Microeconomic models will not successfully predict observed choices when individuals in cross-sectional data have essentially different preference orderings over bundles of the commodities in question.

The second reason why traditional models of consumption and production decisions may not be successful in the case of physicians is that variables usually considered exogenous to the decision process may be under the control of the physician. The typical labor supply equation considers wages (fees) as an exogenous input to the physician's labor supply decision. Though the effect of market forces on physician fees is an unresolved question, few would argue that physicians have no control over their fees. It seems likely that physicians seek a balance between output (labor supply), the unit price of

output (fees) and other practice attributes, with each decision influencing the other.

In this report we have attempted to initiate a new line of inquiry into the ways in which physicians make decisions about their practices. We have considered the possibility that significant differences in preferences over bundles of practice attributes exist among groups of physicians and that traditional microeconomic models may not sufficiently account for these differences. Retaining the economic concept of decisions based on resources, constraints and preferences, we have attempted to develop models in which preferences play a greater role in the decision process. We have described the physician's practice using variables that represent inputs to production of services, output prices and output themselves. We then examined the decisions that physicians make, looking for evidence of underlying structure or mechanisms which generate the observed data. It may be possible to find such evidence even if the mechanism itself is not well understood.

We have found latent characteristics of practices which we refer to as "styles" of practice. These do not represent discrete choices on the part of the physician. Physicians do not choose style (i) instead of style (ii). Rather, we think of physicians as choosing a style which is, for example, strongly characteristic of style (i) or style (ii) (or both) and not strongly characteristic of style (iii). Styles may be thought of as characteristics of the practice which transcends single attributes. These styles appear to be useful in their ability to explain the variance in the attribute variables and they correspond to intuitively appealing concepts of practice style which have arisen from previous research and casual empirical observations. Moreover, the styles are robust when subjected to validation by an independently corrected set of data.

Our next step was to investigate the mechanisms which generate the styles of practice. We posited a block-recursive model in which practice styles were functions of early career decisions by the physicians and exogenous factors such as the physicians age, sex, and experience. The early career choices and exogenous variables were found to be reliable predictors of practice styles in most cases. We tested the models and found the results to be very robust.

The purpose of this research was to outline alternatives ways of analyzing the physician's practice decisions and to demonstrate methodologies which are useful in testing alternative models. There are several extensions of this research which would be particularly interesting given the results to date. First, it seems plausible that practice styles may be strongly influenced by combinations of previous choice variables, such as the choice of specialty combined with the choice of geographic location or size of practice. One simple improvement in our causal models would be the addition of interaction terms representing combinations of previous choices. Secondly, one might argue that anticipation of the effects of specialty choice on practice style leads to a reverse causal effect, that is, the style attributes influence specialty, rather than the reverse. Estimation of models in which specialty and style, for example, are jointly determined involve serious problems of identification. Nonetheless, such models may be better representations of the way decisions are actually made.

Finally, and most importantly, one might expand the causal model to include determination of individual practice style attributes. Our approach has assumed that differences in physician preferences and the structure of constraints all combine to produce the basic latent practice styles. Differences in preferences, and the constraints imposed by previous choices

CMS LIBRARY
3 8095 00012802 1